

RADIO *and* ELECTRONICS

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

Announcing
CHANGE OF NAME

PLEASE TURN TO
PAGE 17
FOR AN
IMPORTANT
ANNOUNCEMENT



APRIL 1st, 1954

VOL. 9, NO. 2

Two valves - very rare

BRIMARIZE - don't despair.


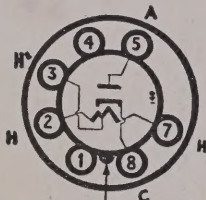
TYPES 35Z5GT and 45Z5GT are half wave rectifiers commonly used in American AC/DC receivers. Both of these valves employ tapped heaters, across a section of which the dial lamp is usually connected.

Direct substitution by type 35Z4GT will render the lamp inoperative, the rest of the set functioning as before.

If dial illumination is necessary, the lamp may be connected directly in series with the heater chain provided it is shunted with a suitable resistor.

Alternately a 0.3 amp. lamp may be employed, wired in series with the negative mains lead i.e., between mains switch and chassis.



		CHARACTERISTICS		
		35Z4GT	45Z5GT	
		35Z5GT		
 Type 35Z4GT	 Type 35Z5GT 45Z5GT	Heater Voltage	35	45 volts
		Heater Current	0.15	0.15 amp.
		R.M.S. Input	250	235 volts
		Rectified Current	100	100 mA

CHANGE VALVE		CHANGE SOCKET		OTHER WORK NECESSARY	PERFORMANCE CHANGE
FROM	TO	FROM	TO		
35Z5GT	35Z4GT	Int. Octal.	NO CHANGE	Disconnect lamp leads from valve socket and connect in series with the lead to pin 7. Shunt lamp with suitable resistor. See note.	NONE
45Z5GT	35Z4GT	AS ABOVE			

Note :-A 6.3 volt 0.2 amp. lamp requires a shunt resistor of 25-50 ohms 2 watt.



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FOR SPECIAL ANNOUNCE-
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Official Journal of
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The N.Z. Radio and Electrical Traders'
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Managing and Technical Director:
W. D. FOSTER, B.Sc.

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1st April 1954

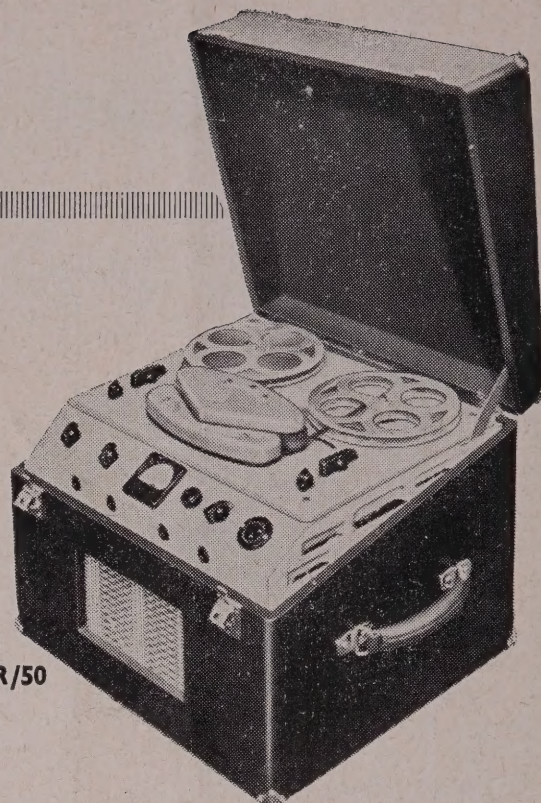
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Model L/2



Model TR/50

E.M.i. Tape Recorders for professional use.

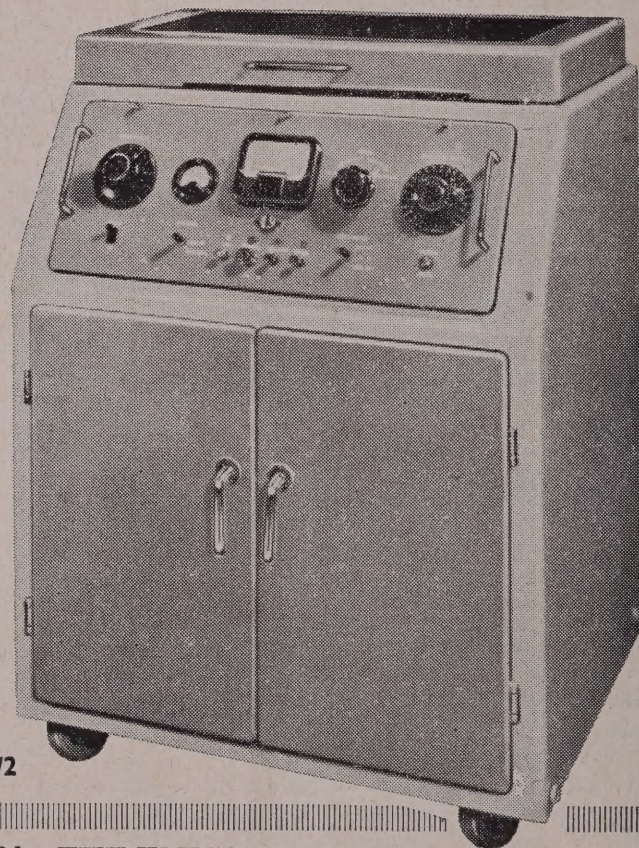
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Model TR/50—a Mains/Portable recorder available in two versions with tape speeds of either 15" and 7½" or 7½" and 3¾" per second.

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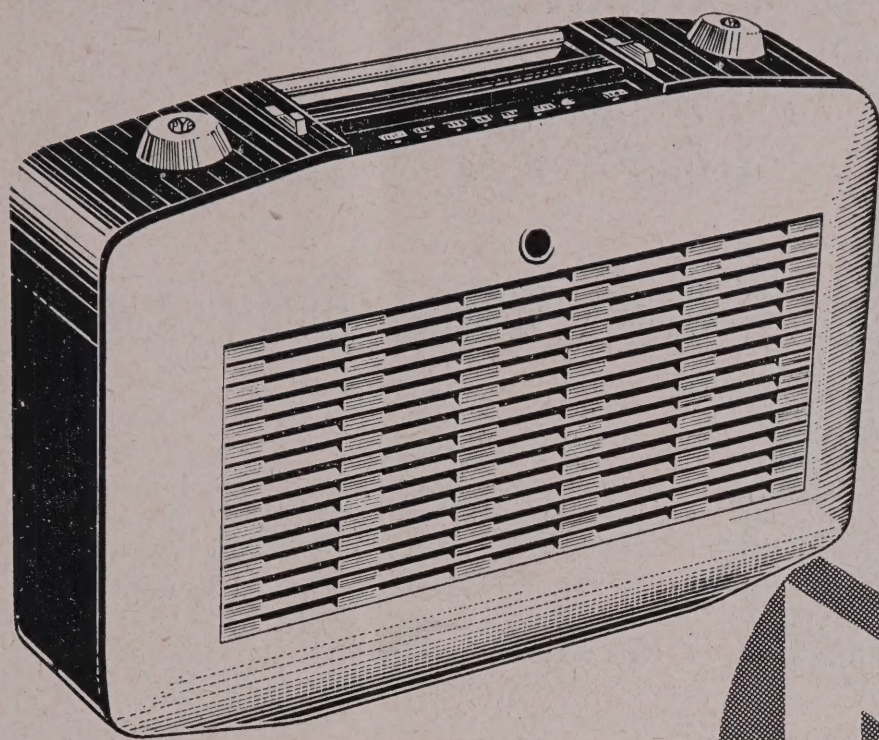
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P61.24

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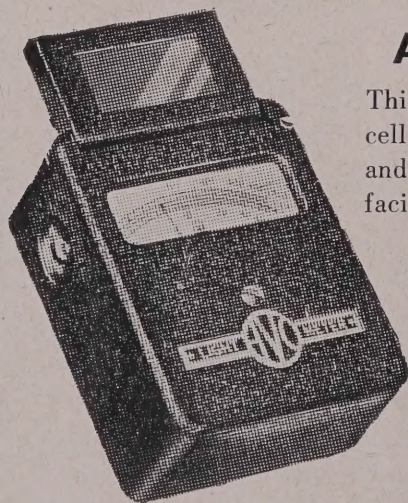
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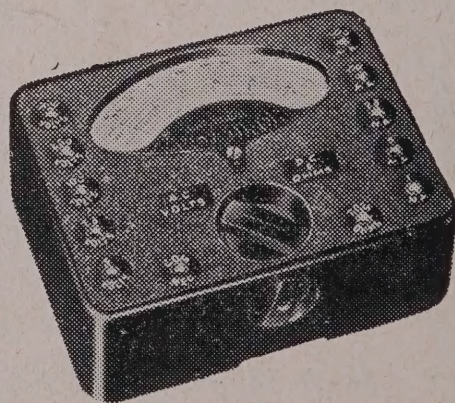
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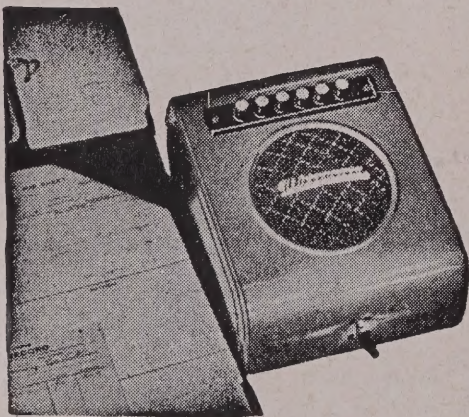
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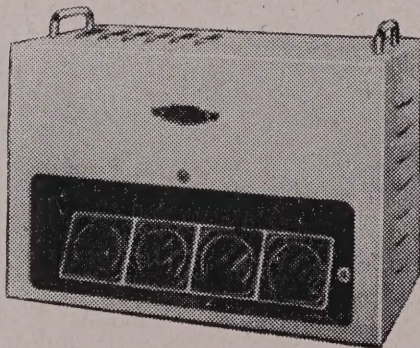
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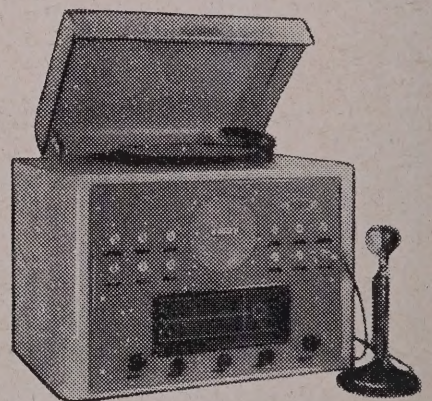
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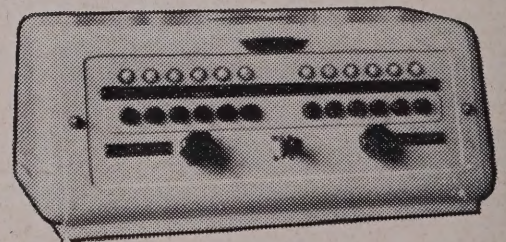
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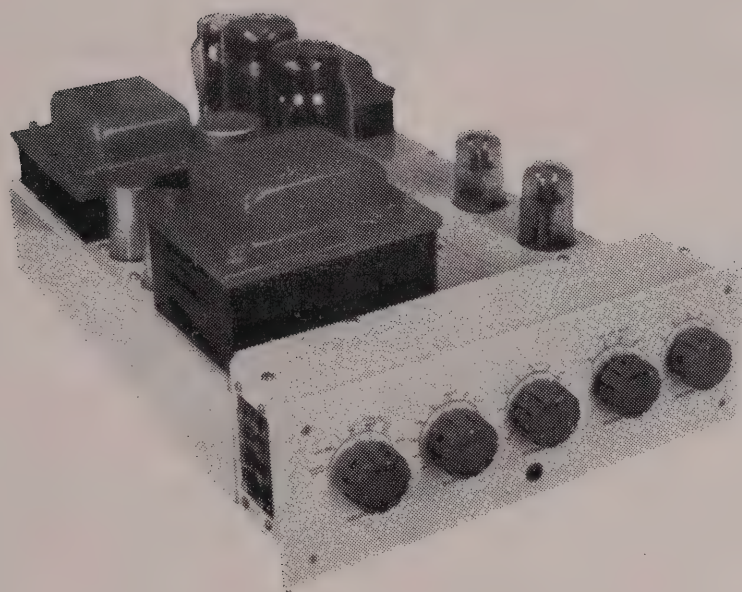
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PF 91: £55 11s. 6d.

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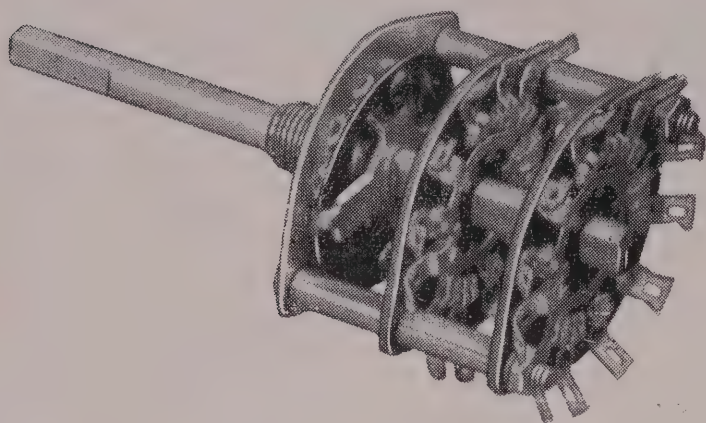
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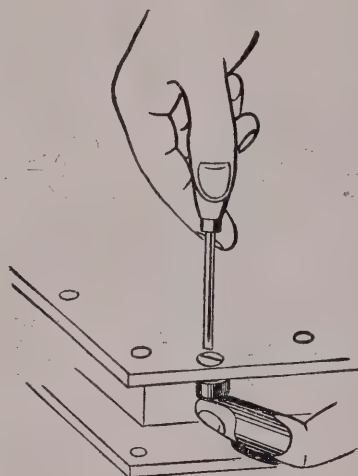
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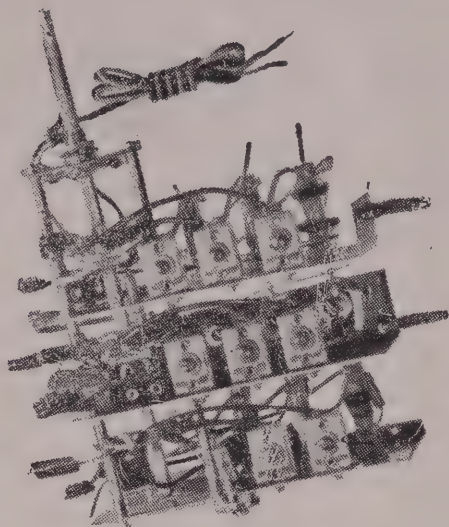
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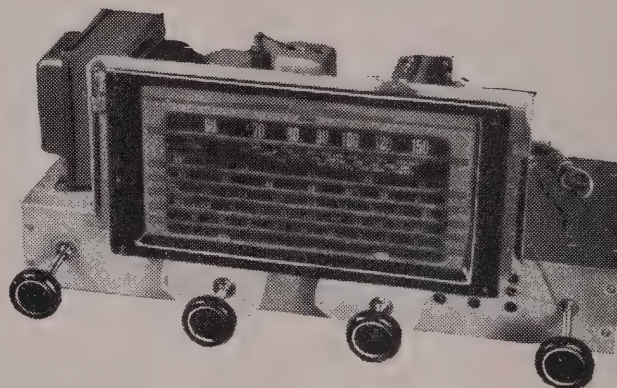
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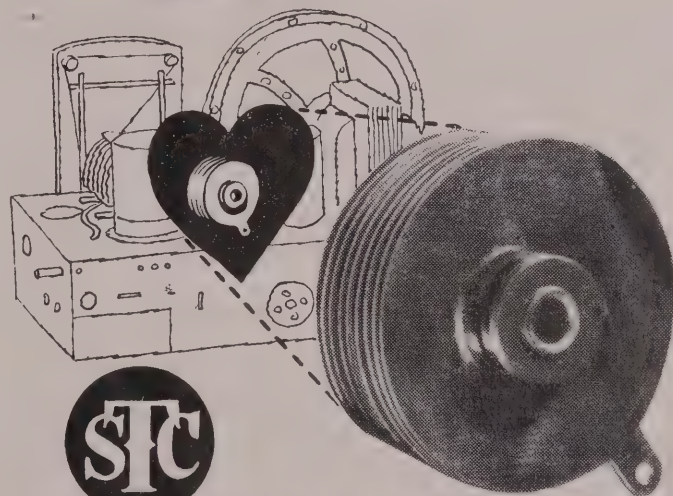
AN APOLOGY

In February's issue there appeared an error for which we must apologise. In the caption to the photograph of the out-sized "Walchris" pick-up head, it was wrongly stated that the "Walchris" firm was domiciled in Sweden. In fact, it is a Danish organization.

"R & E" TECHNICAL PHOTOGRAPHS

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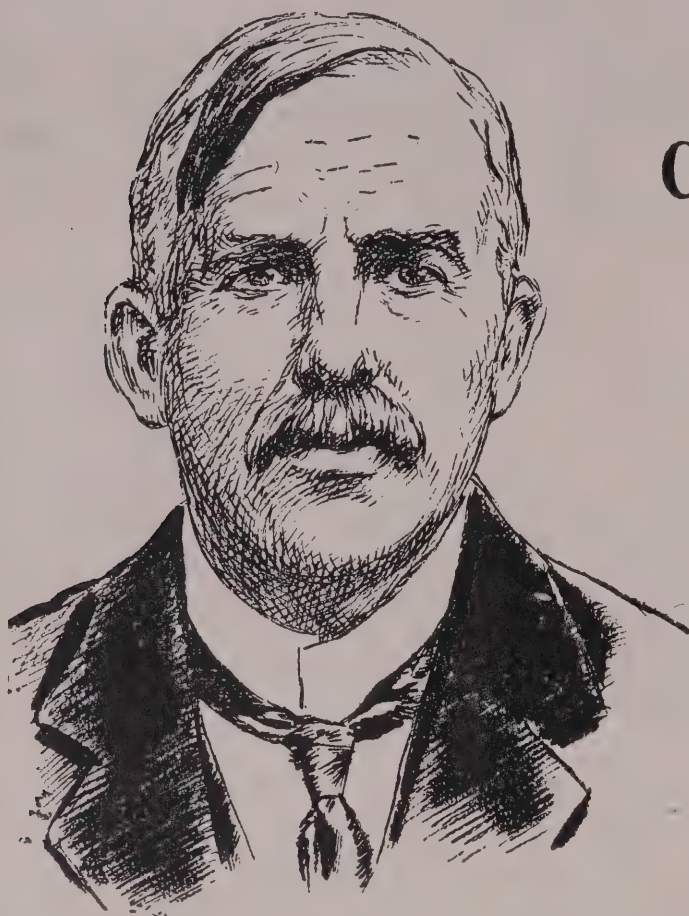
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Lord Rutherford

born near Nelson, New Zealand entered Trinity College, Cambridge in 1894 as a post-graduate student with an already brilliant record. In addition to making successful wireless transmissions over a distance of two miles, he took part in the researches of the great Sir J. J. Thomson, whom he eventually succeeded as Cavendish Professor of Physics. His analysis of the structure of the atom resulted in the discovery that radio-active rays are composed of minute particles, flung off owing to gradual atomic disintegration. This in turn led to one of the most remarkable scientific achievements of the modern age: by means of radio-active bombardment, he was able to change nitrogen into oxygen and realize the eternal dream of the alchemist. When he died in 1937, he and his colleagues had changed the whole concept of physics, and Rutherford's influence had penetrated into all branches of electronics. Such revolutionary advances are nowhere better appreciated than in the Pye factory and research laboratories, where, ever since the late W. G. Pye started making scientific instruments for the University, the Cambridge standards of accuracy and progress have been jealousy maintained.



RADIO AND TELEVISION

PYE (NEW ZEALAND), LIMITED, P.O. BOX 2839, AUCKLAND.

Widening Horizons

This month, as readers will no doubt have observed, brings some quite sweeping changes in *Radio and Electronics*. The most obvious of these are its enlargement from 48 to 56 pages, the addition of a special Trade and Electrical Section, and the placing of the advertisements separately from the main articles and other material for the reader. The last of these will, we think, make for pleasanter reading, but the first two represent a major change in policy, which it is now our duty and pleasure to expound.

In 1946, when our first issue saw the light of day, there was need for a journal devoted on the one hand to those interested in the technical side of radio and electronic work, and on the other to the manufacturer, wholesaler, and retailer of this sort of equipment. To judge from its reception by all concerned, our journal succeeded in a short time in "filling a long-felt want," and we believe it has been doing so ever since.

It has been noticeable for some time, however, that the radio industry has been undergoing a change. Manufacturers have launched forth, and very successfully, too, into the making of electric heaters, irons, jugs, toasters, and many other domestic products. At the same time, wholesalers and retailers have tended more and more to deal not only in radio but in electrical appliances as well, until at the present time a very large proportion are no longer plain radio dealers, but radio and electrical dealers. This fact has recently been highlighted by the New Zealand Radio Traders' Federation (whose official journal we have the honour to be), which at its 1953 annual conference decided that the time had come to change its name to the "New Zealand Radio and Electrical Traders' Federation."

It is in accordance with changed conditions within the radio industry itself that we have decided to enlarge the scope of *Radio and Electronics*. From now on, our special Trade and Electrical Section is intended to provide for the dealer in electrical goods the same kind of service that this journal has always done for the radio dealer. And because, to a considerable extent, the radio and electrical dealer is one and the same person, we hope that in our new form we will be of greater use and assistance than we have been in the past.

To those (and there are many) who have supported us in our role of a technical radio journal, we would like to say that these changes do not in any way indicate a change in our policy of providing technical articles of the kind which have always been our main feature. Articles of technical radio or electronic interest will still be featured, as always, and neither their number nor quality are to be changed. On the contrary, we hope that they will be extended, as the occasion arises.

The space taken up by the new Trade and Electrical Section has been provided by adding extra pages and by the rearrangement of some types of material which we have been printing for some time. We do not think that this, the first of our new issues, represents the ultimate form of this magazine. We want to see both the radio and the electrical sections expanded considerably. There is much potential material for the electrical section which we are sure will also be of interest to radio men, and, on the other hand, we hope to make the electrical section as useful to electrical traders and technicians as the radio section has proved in its own sphere. As a starting-point, we would like to draw attention to the pages headed "For the Technician," in which we print not only our usual commercial radio receiver circuit, for the benefit of those engaged in radio servicing, but also complete and authentic service data on a domestic appliance which is in considerable use throughout the country. We plan to publish articles on heating, lighting, refrigeration, etc, that will be not only of technical interest, but also of practical utility to the merchandiser of such goods. In short, we are out to provide a new service; whether we succeed or not depends largely upon how well we please our readers in the electrical field. We therefore invite all those who may have suggestions for articles that would be of general interest to write and tell us about them. Needless to say, we will be very pleased, too, to consider contributed articles for publication. Payment for these will be made at our usual rates.

A Change Of Name

Having decided to enter a new field, we were reluctantly forced to the conclusion that the name of this journal would have to be changed as the old one is no longer adequately descriptive. Accordingly, as from the May, 1954, issue, *Radio and Electronics* will become *Radio and Electrical Review*. Not only will the new title be more in accordance with our new scope, but it will fortunately submit equally gracefully to the now universally-used abbreviation, "R & E." In order to emphasize the point that what *was* Radio and Electronics is now Radio and Electrical Review, we are not in the meantime changing our cover design, except by way of altering the lettering. We hope our old friends will recognize us in our new guise, for *Radio and Electronics* has not ceased to exist. In short, "R. & E." is still "R. & E."

For the Amateur

Automatic DX-ing on Two Metres

A SIGNAL-FINDING RECEIVER

INTRODUCTION

This journal has for some time been keenly interested in V.H.F. work, especially that part of it which concerns amateur transmitters, and for quite a long time we have felt that the V.H.F. enthusiast had a real need for a receiver which would relieve him of the necessity for sitting at the controls continuously, in order to be sure he is there when some rich and rare DX pops up!

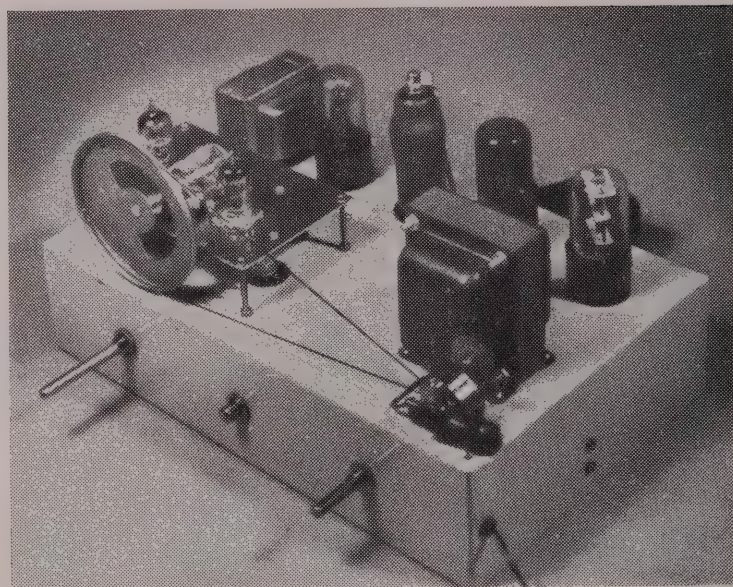
The trouble is, of course, that DX on the six and two-metre bands is largely unpredictable, so that even with the best will in the world, and with the utmost persistence on the part of the operator, it still remains largely a matter of luck whether or not he catches those extraordinary propagation conditions which result in contacts over far greater than line-of-sight distances. We realize, of course, that six metres is relatively little affected by line-of-sight conditions. This was proved conclusively enough by recent experiences in Wellington with the reception of television signals on 45 mc/sec. over paths that were anything but "L.O.S." Two metres, on the other hand, is much more tied down, except under conditions that are known to the research wallahs as "anomalous propagation". But when "anomalous" does occur, even on two metres, the sky is likely to be the limit as far as DX reception is concerned. This is part of the charm of working the two-metre band, because the element of luck adds just that something which appeals to the gambler in all of us. However, being on deck when there is an outbreak of anomalous propagation is largely a matter of extreme patience, unless one can call some mechanical or electronic device to one's aid.

Indeed we have heard rumours that at least one 2-metre enthusiast near Wellington has solved the problem by setting an electric motor to tune his receiver continuously and slowly through the band, so that provided he is in the room with it, he can hear if any signals come on.

Hearing of this made us feel that we had rather been forestalled, because for the last two years or so we have been promising ourselves that we would design a receiver that would do this, and some more besides, and this article is the outcome of these ideas.

PRINCIPLE OF THE RECEIVER

Basically, the receiver is a conventional super-regenerative one comprising a broad-band tuned R.F. stage, a separately-quenched super-regenerative detector, and audio amplifier, and an output stage working a loud-speaker. Instead of a calibrated dial, it is provided with a small electric motor which by means of gearing, and a belt drive to an ordinary dial drum, slowly tunes the receiver over the band and back again. A control circuit is added which, as soon as the receiver comes across a signal, stops the tuning motor, and turns on the loudspeaker. At the same time an extra pair of contacts on the relay used in the control circuit



View of the completed receiver. The R.F. and detector stages are on the small sub-chassis at the left, and the drive motor is in the front right-hand corner. The left-hand control is the super-regeneration control, the other is the volume control, and the push-button in the centre is the re-set switch.

can be made to actuate any additional warning device that may be desired, such as a light or an electric bell.

By controlling the receiver automatically in this way, from its own received signal, it is possible for the set to be entirely silent until it finds a signal and turns up its own audio system, after stopping in tune with the signal. With such a device in the shack, it will be possible for the would-be 2-metre operator to do something else, such as work one of the low-frequency bands, read, indulge in some constructional work, or even go to sleep, in the sure knowledge that if the band opens up, he will automatically be advised of the occurrence!

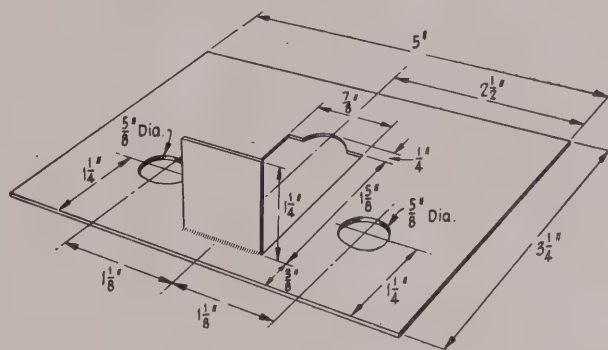
We do not suggest that the super-regenerative receiver is one that is infinitely desirable for DX work, and there is no doubt that most real 2-metre enthusiasts will have receivers which are much better than this one from the point of view of sheer performance, but the super-regen. was chosen on account of the ease with which it can be made to perform the automatic control functions required for a signal-seeking device. In the first place, it is more sensitive, valve for valve, than any other kind of receiver. Secondly, its characteristic hiss in the absence of a signal is very easily made to perform the control functions. Adding the same control circuits to an ordinary superhet could no doubt be done, but would call for more or less drastic modifications; and if one has an excellent

From this description, it can be seen that any signal which is able to reduce the control bias sufficiently

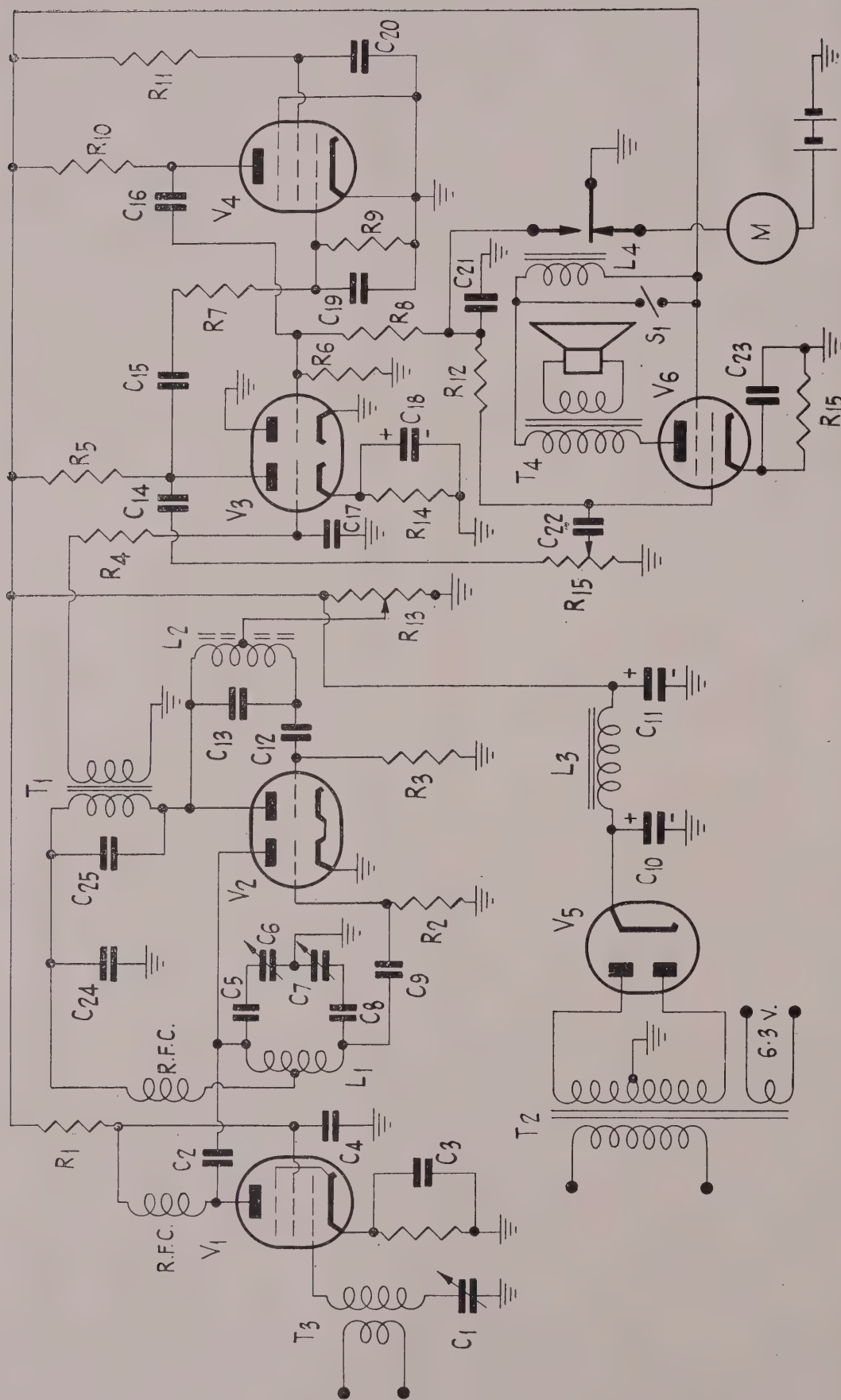
Technical drawing of a rectangular plate with dimensions and hole locations. The plate has overall dimensions of $11\frac{1}{2}$ inches in width and $7\frac{1}{2}$ inches in height. The drawing shows the following features:

- Holes:**
 - Four holes labeled 'A' are arranged in a horizontal row at the bottom, with a center-to-center spacing of $2\frac{1}{4}$ inches. The first hole 'A' is positioned $2\frac{3}{4}$ inches from the left edge and $1\frac{3}{4}$ inches from the bottom edge.
 - Two holes labeled 'C' are arranged vertically on the left side, with a center-to-center spacing of $1\frac{3}{4}$ inches. The top hole 'C' is positioned 2 inches from the left edge and $2\frac{3}{4}$ inches from the top edge.
 - Two holes labeled 'D' are arranged horizontally in the center, with a center-to-center spacing of 2 inches. The left hole 'D' is positioned $2\frac{1}{8}$ inches from the left edge and $1\frac{1}{8}$ inches from the bottom edge.
 - Two holes labeled 'E' are arranged horizontally on the right side, with a center-to-center spacing of $1\frac{1}{2}$ inches. The left hole 'E' is positioned $1\frac{1}{4}$ inches from the left edge of the hole group and $1\frac{1}{2}$ inches from the bottom edge.
- Dimensions:**
 - Overall width: $11\frac{1}{2}$ inches.
 - Overall height: $7\frac{1}{2}$ inches.
 - Distance from left edge to the center of the first hole 'A': $2\frac{3}{4}$ inches.
 - Distance from the center of the top hole 'C' to the top edge: $2\frac{3}{4}$ inches.
 - Distance from the center of the left hole 'D' to the left edge: $2\frac{1}{8}$ inches.
 - Distance from the center of the left hole 'D' to the center of the right hole 'D': 2 inches.
 - Distance from the center of the right hole 'D' to the right edge: 2 inches.
 - Distance from the center of the top hole 'C' to the center of the left hole 'D': $4\frac{1}{2}$ inches.
 - Distance from the center of the left hole 'D' to the center of the right hole 'E': $1\frac{1}{4}$ inches.
 - Distance from the center of the right hole 'E' to the right edge: $1\frac{1}{2}$ inches.

DRILLINGS: A = $1\frac{5}{32}$ " Dia. B = $\frac{3}{4}$ " Dia. C = $\frac{5}{8}$ " Dia.
D = $\frac{1}{2}$ " Dia. E = $\frac{3}{8}$ " Dia.



It is realized that this general scheme is open to certain objections. For example, as soon as one signal appears on the band, the receiver finds it and stops searching. It has no means of distinguishing between local signals and DX ones, so that it will do its stuff



V₁, 6AK5 or 6F91.

V₂, 6J6 or ECC91.

V₃, 6SN7.

V₄, 6J7.

V₅, 6V6.

V₆, 6X5.

C₁, 3-30 μmf. Philips trimmer.

C₂, C₃, 5 μmf.

C₄, C₅, 0.001 μf.

C₆, C₇, 18 μmf. per section split-stator.

C₈, 3 μmf.

C₉, 8 μf. Electro.

C₁₀, 16 μf. Electro.

C₁₁, C₁₂, C₁₃, C₁₇, 500 μmf.

C₁₈, C₂₀, 25 μf. 25v. Electro.

C₁₄, C₁₅, C₁₆, C₂₂, 0.01 μf.

C₁₉, 50 μmf.

C₂₀, 0.05 μf.

C₂₁, 25 μmf.

C₂₅, 100 μmf.

R₁, 10k.

R₂, R₆, R₈, R₁₁, R₁₂, 500k.

R₃, R₄, 27k.

R₅, 250k.

R₇, 3 meg.

R₉, 5 meg.

R₁₀, 100k.

R₁₃, 25k. w.-w. pot.

R₁₄, 7.5k.

R₁₅, 250 ohms (cathode of V₆).

R₁₅, 1 meg pot and cathode

resistor V, 200 ohms.

T₁, 2: 1 step-up audio Xformer.

T₂ power Xformer, 180v-a-side. 30 ma.

T₃, aerial coil, see text.

T₄, output transformer, 6V6 to v.c.

L₁, detector coil, see text.

L₂, quench coil, see text.

L₃, midget smoothing choke.

L₄, relay coil, see text.

S₁, push-button switch.

M, tuning motor, see text.

whoever is on the air. Again, in some localities, harmonics of transmissions on entirely different frequencies may turn up in the 2-metre band, and should this occur, the receiver will find the offending signal, and refuse to keep on searching. However, by means of a simple mechanical addition to the system, it would be possible to over-ride the mechanism at any one spot on the dial, so that a particular signal can be ignored by the receiver.

CIRCUIT DETAILS OF THE RECEIVER

The heart of the receiver is the 6J6 super-regenerative detector. In the absence of a 6J6, the stage can use an ECC91, which is a direct electrical equivalent. The circuit is a separately-quenched one, and will be found very simple to get going. The left-hand section of the valve V_2 in the circuit diagram is the signal-frequency oscillator, and is a simple Colpitts using a midget split-stator condenser. Bandspreading is obtained by means of 5 $\mu\text{mf.}$ fixed condensers in series with each half of the tuning condenser, and the range covered by the receiver is from about 142 to 150 mc./sec., thus leaving a reasonable margin on either side of the band for possible off-band transmissions. This half of the 6J6 is the super-regenerative detector proper, the other half being used as the quench oscillator. This one is a Hartley oscillator using a centre-tapped coil wound on a miniature Ferroxcube pot-type core. The detector is made to super-regenerate by the simple expedient of plate-modulating it with the quench oscillator. Were it not for the fact that we require to take off the audio component of the detector plate current, we could connect the R.F. plate choke of the detector directly to the plate of the quench oscillator. As it is, we interpose in this lead the primary of an audio transformer, at the secondary of which the detector output appears. In order that the transformer primary shall not block the quench voltage from the R.F. oscillator, it is bypassed by C_{25} , of 100 $\mu\text{mf.}$ C_{24} is a 25 R.F. bypass to ensure proper functioning of the R.F. oscillator. It has some slight bypassing effect on the output of the quench oscillator, but this is allowed for by choosing C_{25} so that the required amount of quench voltage is applied to the plate of the R.F. oscillator. The latter obtains its D.C. plate voltage from the connection to the quench-oscillator plate, and both oscillators can have their plate voltage simultaneously adjusted by means of the potentiometer R_{13} . This is brought out to the panel as a super-regeneration control. It has to be used only very infrequently, so that if desired it can be regarded as a pre-set adjustment, and placed in a more inaccessible spot. It should only be necessary to adjust it when setting up the receiver initially, and when changing detector tubes.

V_1 is a 6AK5 tuned R.F. amplifier. It is choke-capacity coupled to the detector circuit, and has so-called series tuning in its grid. If a 6AK5 is not available, an EF91 may be used instead. This tube is very bit as good as the 6AK5, with somewhat similar characteristics, but has different base connections. The main purpose of using an R.F. stage in the receiver is to reduce the amount of radiation from the detector, since this could cause interference. It is by no means essential, however, and can easily be omitted if desired by adding a two-turn coupling coil to the detector tuning coil.

The remainder of the receiver is the audio and control section. V_3 is a 6SN7, the left-hand section of which is a resistance-coupled audio amplifier, and is common to both the audio and control circuits. The

right-hand section is used as a diode for the function of control-bias rectifier. If the circuit is traced out, it will be seen that the first audio stage feeds (1) the audio volume control in the grid circuit of the output stage, and (2) the grid of the control amplifier, V_4 . The latter is merely a further audio amplifier, coupled by a blocking condenser to the rectifier diode. It is important to note that the section of the 6SN7 used as a diode has its plate earthed, and that the grid is used as the diode plate. There is a reason for this, which should be appreciated by anyone wishing to duplicate the arrangement. The gain between the grid of the amplifier section of the 6SN7 and the rectifier section is quite high—some 1300 times—so that relatively little feedback of audio voltage from the rectifier into the first audio stage can cause oscillation. However, by earthing the plate, this electrode acts as a shield between the two sections of the valve, and all is well. The diode load is R_6 , of 500k. and the components R_8 and C_{21} act as an audio filter, removing the audio component, and thus ensuring that the output of the rectifier is almost pure D.C. The grid leak of the 6V6 output stage is R_{21} , and instead of being returned straight to earth, as is the usual practice, it is joined to the output of the rectifier filter. Thus the D.C. voltage developed by the diode is applied to the grid of the 6V6. The latter is also provided with the usual cathode bias resistor and bypass condenser, so that when the control bias is removed, it becomes normally biased to act as an ordinary audio amplifier stage. The relay winding is in series with the plate lead of the 6V6. It will be noted that only a single change-over contact is shown, as this is all that is required to make the system work. Should an auxiliary alarm device be needed, this can be operated simply by having a relay with a pair of normally open contacts on as well as the change-over set. The additional contacts then close when the relay is energized, and can be used to operate any electrical device that one wishes. The tuning motor is represented by M on the diagram, and it is connected to the normally closed contact of the change-over set. Thus as long as the relay is not energized, the motor circuit is closed, and the motor running. The moving contact is earthed, and the normally open contact is connected to the output of the rectifier filter. Thus, when the relay is energized, the lower end of the 6V6 grid leak is earthed. The push-button switch S_1 is connected across the relay coil, and is the re-set switch which enables the receiver to start scanning again by opening the relay and allowing the control circuit to take charge once more.

SPECIAL COMPONENTS

An unusual job like this one usually is found to contain a number of special components that are often hard to come by. In this set, such things have been reduced to the barest minimum, and those there are are either readily available, or else can easily be improvised.

Quench Coil Former

This is really the only special component that will have to be bought, apart possibly from the drive motor and the relay. It is a standard part, however, and can be had from the maker's representatives complete with the minute bobbin that is intended for it. The coil is made by winding 160 turns of fine wire, with a tap at the centre. The miniature pot has a hole through the centre, through which a small bolt can be placed for mounting purposes. Since these pot cores

have no external field, they may be mounted directly on to a metal chassis without causing any trouble. It should be mentioned that the pot used is the smallest one available, and measures only about $1\frac{1}{2}$ cm., or $\frac{5}{8}$ in. in diameter. To get 160 turns on the bobbin, you will have to use very fine wire, at least 40 gauge.

We should perhaps mention that the desired quench-oscillator frequency is 50 kc/sec., and that provided you can rake up a coil that can be tuned to approximately this frequency, the circuit is in no way critical. For instance, instead of the pot core, it is quite possible to use the windings from a 175 kc/sec. I.F. bobbin. These can be bought without cans or other impedimenta, and the drill is to warm the former so that the two windings can be slid as close together as possible. This done, the outer connection of one is joined to the inner of the other (provided that winding directions are the same) to form the centre-tap. If this scheme is used, a tuning capacity of between 500 μ f. and 1000 μ f. will tune the coil to approximately 50 kc/sec. In practice, the exact frequency does not matter provided it does not come out higher than 100 kc/sec.

Relay

The relay used in the prototype was a B.P.O. 3000 type, having a 200-ohm coil. This relay was found to pull in at a current of about 15 ma.; there is absolutely no necessity to use an exactly similar relay. Any relay that will come in on 15 ma. or less will do the trick, provided it has the necessary set of change-over contacts. There is certainly no need for a super-sensitive relay, and a modified ZC1 keying relay should be capable of doing the job satisfactorily. Incidentally, the rather low coil resistance (and therefore low audio impedance) of the relay used enabled us to get away without bypassing the relay coil for audio frequencies. And should a high-impedance relay be used, it will be necessary to put a bypass condenser across it, otherwise all the audio voltage will be developed across the relay coil, and very little across the speaker transformer primary.

Tuning Motor

In the absence of suitable small A.C. motors, we used on the prototype a midget D.C. motor called a "Mighty Midget." This is available at many toy or model shops and is ideal for the purpose in that it comes complete with built-in six-to-one-gearing, and its own pulley. All we needed to do, as can be seen from the photographs, was to mount it on a pair of rubber grommets on the chassis (anti-vibration) and make a belt out of some stout cotton, taking this over the motor pulley and the dial drum. However, any small D.C. motor will do, and there are several types available now in the toy shops. The consumption is low, so that running them from dry batteries will not prove ruinous!

Construction

The photographs give a good idea of the lay-out used. The set is self-powered, using a small power transformer which gives 190v. a side at 35 ma. The output of the filter is only 200 volts or so, which is all that is wanted. Indeed the set is purposely run at low voltage, (a) because the R.F. amplifier tube is not supposed to have more than 180v. on its plate, and (b) so as to reduce the current consumption of the 6V6. Also, putting lower voltage on it than 250, reduces the amount of control bias necessary for cutting it off. Therefore, if a separate power supply is used, do not give the set anything more than 200 volts of H.T. The receiver proper,

i.e. the R.F. and detector stages, were built on a small sub-chassis, and mounted on long bolts above the main chassis in order to make the attachment of a dial drum to the midget tuning condenser easier. Besides, it is much easier to build this part of the set separately, since the components are small and fiddly, and it helps not to have to do it inside the main chassis. The audio transformer is a standard one with a 1:2 step-up ratio. It seems that this is the only kind of cheap audio transformer currently made here, but if you have an old-fashioned audio transformer with a higher ratio, by all means use it. It will be rather better in some ways. The 6SN7 is next to the A.F. transformer, with the 6J7 following, and the 6V6 at the right-hand end. The relay and the smoothing choke are mounted underneath the chassis, as there is plenty of room for them there.

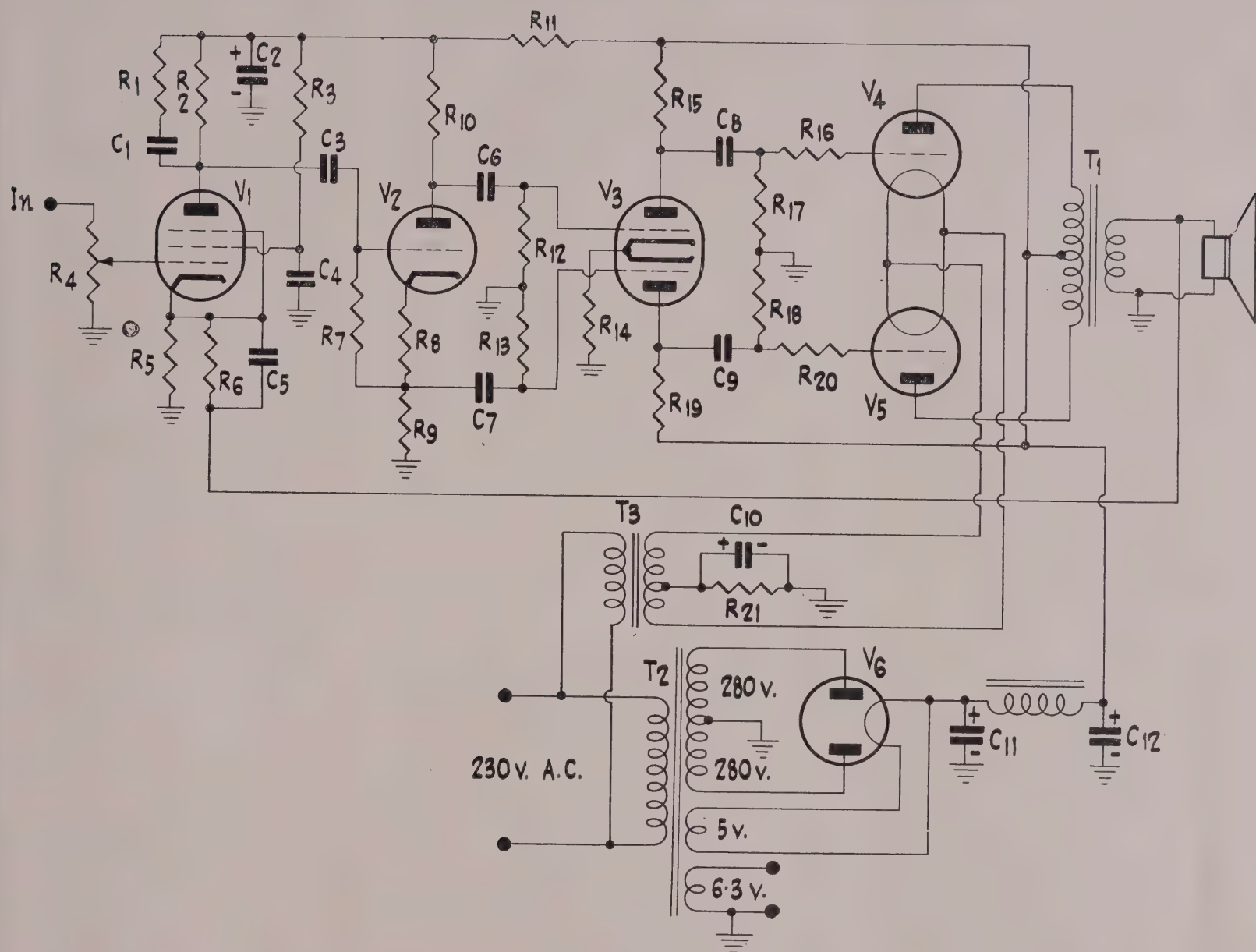
In wiring up the R.F. end of the circuit, make sure that the best V.H.F. practice is used by way of making leads as short as possible, etc. You will note that the valve sockets have been placed as close to the tuning condenser as they would go, so as to make the leads from the detector and the plate lead from the R.F. amplifier as short as practicable. Seeing the audio transformer is on the main chassis, the number of parts on the sub-chassis is not very great, and the layout will look after itself. The 5 μ f. fixed condensers in the tuned circuit are of the disc ceramic type, and so take up very little length. They are mounted as short up on the stator lugs of the tuning condenser as possible, and the other ends, also cut off very short, go directly to the wire ends of the tuning coil. To make a good job of this sort of circuit it is only necessary to be sure to provide insulated tie-points for junctions that require mechanical support, and not to shirk work by avoiding them, letting floppy wiring go as "good enough". If this is done, and the leads are kept short, then no difficulty at all will be experienced.

One point which was not mentioned in the above discussion of the circuit, was that of filtering out the quench frequency from the control circuits. At the primary of the detector output transformer, there is a large voltage at the quench frequency, and although this is considerably higher than audio frequencies, the amplifier stages have enough amplification there to cause the control rectifier to conduct permanently, if the 50 kc/sec. signal is not prevented from reaching it. Should this happen, it is obvious that control bias will be developed regardless of the presence or absence of the super-regenerative hiss that is supposed to actuate the rectifier. Indeed if there is enough quench voltage present, it can completely stop the control circuit from functioning. It is for this reason that we have a filter of 20k. and 500 μ f. between the audio transformer secondary and the grid of the first audio stage. Similarly, we have 3 meg. and 50 μ f. in front of the grid of the 6J7 stage, to provide further filtering. If an old type of transformer is used, it may be possible to dispense with these filters, but on no account should they be omitted until one is sure that the circuit will function without them.

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Audio Amplifiers

A Modern Circuit for "Forty-fives"



INTRODUCTION

We have so often been asked for an audio amplifier circuit using the old faithful 45, that we have developed the circuit described here. Once-upon-a-time, as the story-books say, there was only one audio power valve, and its name was 45. Indeed, it was the first receiving valve that had a reasonably high power output combined with a low H.T. voltage, and reasonable price. So good a tube was it, that even to this day it is to be found in the catalogues, and better still, on dealers' shelves. True, it is directly heated, and judged by modern standards, it has a low amplification factor and mutual conductance, but in the words of the mighty, "So what?" A pair of them in push-pull can provide a good five watts of audio power, and they have all the virtues possessed by triode output valves. That is to say, they are not critical as to operating conditions, their inherent distortion is not high, and even without modern refinements such as negative feedback, they can give really excellent performance. Their current requirements are not excessive either, so

R_1 , 10k.	C_2 , C_{11} , C_{12} , 16 μ f. 450v. electro.
R_2 , R_6 , R_{10} , R_{15} , R_{19} , 100k	C_3 , C_4 , C_6 , C_7 , C_8 , 0.1 μ f.
R_3 , R_{17} , R_{18} , 250k.	C_5 , 50 μ f.
R_4 , 500k. pot.	C_9 , C_{10} , 0.25 μ f.
R_5 , 2k.	C_{10} , 50 μ f. 50v. electro.
R_6 , R_{11} , 27k.	V_1 , EF37A.
R_7 , R_{12} , R_{13} , 500k.	V_2 , 6J5.
R_8 , 5k.	V_3 , 6N7.
R_{16} , R_{20} , 15k.	V_5 , V_4 , 45.
R_{21} , 750 ohms.	V_6 , 6Y3.
R_{14} , 1,500.	T_1 , 5,000 ohms. to v.c. (see text).
C_1 , 100 μ f.	T_2 , and T_3 , as marked.

that a really high-quality amplifier can be readily built round them at very reasonable cost.

One might ask, however, why 45s should still be used when there are more modern tubes that presumably should be better. The answer to this is to be found in their electrical size. For example, triode-connected KT66s,

such as are used in a good many excellent amplifiers, are much larger, and give more output than many people need. Also, if they are fully utilized, the supply requirements are pretty heavy, so that the power pack becomes a very expensive item. At the other end of the scale, push-pull triode-connected 6V6s, for example, will give only about four watts output at the most. Thus we find that the 45, with power output intermediate between the two extremes mentioned, is still a very useful tube. The amplifier described here uses a pair of 45s in a circuit that is right up-to-the-minute as far as modern technique is concerned, and which should give results little if at all inferior to even the most costly amplifiers, at only a fraction of the cost.

THE CIRCUIT

Cathode bias is used for the output tubes. It is much simpler than fixed bias, it needs fewer components, and above all it gives the least trouble. The one disadvantage of 45s these days is that their filament voltage is only 2.5, while the other valves in the amplifier have 6.3-volt heaters. While it is possible to have a power transformer specially made with a 2.5-volt winding, the better solution is to buy a small filament transformer. These are stock items, and the two transformers will cost little more (if any) than would the special power transformer. Also, one will not have to wait while it is made. The output transformer is a standard 20-watt multi-match, which as we have remarked before, can almost be regarded as a high-fidelity job if it is used at power levels of the order of five watts.

The driver stage follows the best modern practice by being push-pull, and is preceded by the phase inverter, which is that excellent old-timer, the split-load amplifier. A single 6N7 is used as the driver, and is easily able to supply the large grid signal required by the 45s, with very little distortion. Grid stoppers are used between the coupling condensers and the grids of the 45s, as a precaution against parasitic oscillation. This is again modern practice, and is well worth-while, especially when one does not have an oscilloscope with which to ensure that such oscillations do not exist.

The bias resistor of the 6N7 is not bypassed, as this helps to counteract any unbalance that might creep in as resistors, etc., age. It also helps to improve the push-pull balance should the plate and cathode load resistors of the phase inverter not be exactly equal when the amplifier is built.

The main voltage amplifier is a modern low-noise pentode, the EF37A, which is remarkable for the small amount of hum and noise it generates. The first two stages are decoupled from the H.T. line by the filter R_{11} and C_2 . This acts as additional smoothing, giving a particularly hum-free H.T. voltage for that part of the circuit which is most sensitive to hum, and at the same time helping to prevent that bugbear of high-fidelity amplifiers, motor-boating.

Across R_2 , the 100k. plate load resistor for the EF37A, is to be found a simple network R_1 - C_1 , whose duty it is to prevent the amplifier from oscillating at some frequency outside the audible range. This is always a possibility when negative feedback is used, as it is here, and this simple CR circuit is a very good precaution to insert. It costs almost nothing, and saves a good deal of possible puzzlement and disappointment, should there be a tendency towards high-frequency oscillation for any reason at all.

Negative feedback is applied from the voice coil winding of the output transformer to the cathode of the

EF37A. The amount given by the values shown is approximately 16 db., which corresponds to a gain reduction of 6.3 times. As a result, the distortion at maximum output power is something less than one per cent.—a low enough figure to put the amplifier into the high-fidelity class. With feedback applied, the input signal needed for full power output is 0.5v. peak.

It should be pointed out that the feedback resistor R_3 has been specified on the assumption that a 15-ohm speaker is used. If any other speaker impedance is used, the value of this resistor will have to be changed in proportion to the square root of the impedance. This relation gives the following table:—

R_3	Imp. of speaker
27k.	15.0 ohms
20k.	8.0 ohms
15k.	4.0 ohms
10k.	2.5 ohms

POWER SUPPLY

The power supply components are clearly shown on the diagram. The power transformer need be rated to deliver only to 100 ma. The former figure will do if no tuner is to be run from the same supply, while the larger one will be needed if the supply is to feed any other equipment at the same time as the amplifier.

CONSTRUCTION AND LAYOUT

The construction can be quite conventional, and the amplifier is best laid out according to the run of the circuit diagram. The power supply components, and in particular the power transformer should be mounted as far away as possible from the input end of the amplifier. This is essential if hum pick-up by the grid of the EF37A is to be avoided. The only point that might need watching specially apart from this is the manner in which the feedback is connected. In particular, an amplifier like this, in which feedback is taken from the output transformer secondary, should ALWAYS have the output transformer mounted on the chassis, and should not have it on the speaker frame, as is the case with most radio receivers. Also, the voice-coil should not be earthed just where the lead comes out of the transformer. The proper way to connect the feedback is as follows: The



voice-coil leads are connected to the speaker plug first of all. Then, two insulated wires are threaded through a piece of shield braid, and are taken back to the vicinity of V_1 . One of the insulated leads is earthed at the same point as is used for earthing the cathode resistor R_5 . An insulated tie-point is installed close to the same point, and from it R_6 is wired to the cathode of V_1 . The remaining voice-coil lead is then terminated on the same tie point as is used for the outer end of R_6 . When all this is done, the shield braid is earthed at several places along its length.

Now to those who have not done much audio construction, this might seem like a good deal of fuss about very little. On the contrary, it is most important, and we would not mind being given a pound for every feedback amplifier which has oscillated through not having the feedback connection made in this way. If one side of the voice-coil is earthed at some distance from the input of the amplifier, the audio feedback current has to complete its circuit through the chassis. On the way it can quite easily cause unwanted coupling with some other part of the circuit, and this coupling can be the cause of the whole amplifier bursting into oscillation. If the wiring is done as outlined here, however, the possibility of trouble from this cause is eliminated.

ON FIRST TURNING ON

After the amplifier has been built and the circuit checked over, the first thing to do is to turn it on with the feedback disconnected. The reason for this is that by trial, there is no way of telling which of the voice-coil leads should be earthed, and which should go to the feedback resistor. The way to find out, therefore, is to turn the amplifier on, and softly play some music through it. The feedback leads are then connected to the voice-coil terminals. If the connection is the right way round, the volume will decrease greatly. If not, the volume will increase, and in all probability tremendous distortion will result. In this way the right connection can be found, and the feedback leads permanently soldered in place. The feedback leads, of course are the ones which are taken through the shield braid back to the EF37A. By doing things in this way, there will be no need to undo any permanent connections.

The amplifier will now be completely operational, and all that is necessary now to obtain first-class reproduced music from it is to feed it with the output of any good pick-up, followed if necessary by one of the many equalizer circuits that have appeared in these pages. But make sure that the equalizer chosen suits the type of pick-up used. The results from a high-fidelity magnetic pick-up will hardly be gratifying if it is used without any equalization, or with one that is suitable only for a crystal pick-up!

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Care of Switch Contacts

By P. A. G. HOWELL

With many small switches used in radio and electronic equipment, including wave-change and toggle types, the effective life is considerably shortened by their developing intermittencies long before complete mechanical failure would ordinarily occur. This is due to a variety of causes, including loss of plating and consequent corrosion, the assimilation of dirt, burning of the points, etc. Furthermore, it is commonly believed that these conditions are aggravated by grease on the contacts, so that many people employ carbon tetrachloride, and other solvents, and remove any grease which exists there. Where the switch was intermittent due to the accumulation of dust and dirt, this usually brings temporary relief, but the latter condition is often worse than the former, for, in the absence of grease, the switch points wear both physically and electrically much more rapidly, and soon the trouble repeats itself. It should, however, be obvious from the state of new switches of the wave-change type that they have been deliberately greased by the manufacturer. This is not a coating put on to prevent corrosion temporarily while the switch is in store before it is put into use.

The purpose of this greasing is twofold: firstly, it acts as a lubricant between the relatively delicate, plated surfaces of the contacts; and secondly, the hydro-carbon atmosphere generated when small quantities vaporize during sparking inhibits oxidation and burning of the points, and assists in quenching the spark. Occasionally, the conversion of some of the carbon into the "sooty" form may cause slight leakage; however, this is easily cleaned off and is much less serious than the wear and corrosion which takes place between bare contacts, as the Admiralty technician, J. J. Payne*, has shown. Switches of the self-cleaning type, where there is a wiping action between the contacts should be properly re-greased after cleaning, and a complete dipping of the wafers into a solution consisting of 10 per cent. lanolin in white spirit seems satisfactory. The life of a well-made switch, regularly cleaned and lubricated may thus be apparently prolonged indefinitely, or at least until major mechanical failure takes place.

When the switch is not of the self-wiping type, however, and in particular with toggle switches, pressure-stud contacts, and variable inductance rotating grooved wheel contacts, a different form of lubricant is required, since there is a tendency for lanolin to harden on continued exposure to the air in a cool climate, forming an insulating layer and so causing intermittency where it is not wiped away by the action. A grease with a lower melting-point is required, and petroleum jelly or "vaseline" dissolved in carbon tetrachloride is recommended, for it has proved most satisfactory in practice.

Where it is not feasible to dismantle a wave-change switch, this liquid may be brushed on to the contacts, after cleaning them. A camel-hair brush should be used, taking care to see that none of the hairs are pulled out and remain in the switch mechanism. Toggle switches which see much service, such as those used for station switching on low-impedance intercommunication lines, are treated, when they become intermittent, by pouring a few drops into the switch down the barrel into which the toggle is fitted. This almost invariably clears the fault, and, by lubricating the bearings, often improves the mechanical action of the switch.

Some difficulty may be encountered in making up the solution, inasmuch as the petroleum jelly takes an appreciable time to dissolve. It was found that the process could be speeded up, however, by melting the grease and pouring it into the carbon tetrachloride. Although carbon tetrachloride is not inflammable, it should not be heated on account of the danger of breathing the vapour given off, which could quickly lead to loss of consciousness. When the solution becomes super-saturated, a layer of yellow petroleum jelly will be seen floating on the surface; sufficient carbon tetrachloride should then be added to just dissolve this.

*Reference: "Cleaning Contact Switches," by J. J. Payne, "Wireless World," February, 1948.

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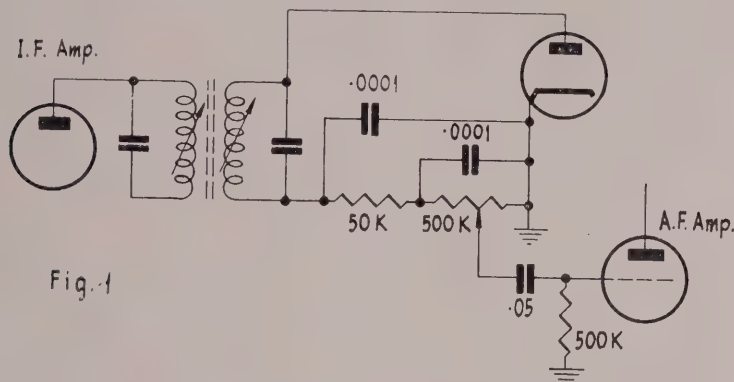
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Circuits for the Experimenter

Push - Pull Without Phase Inverters

Such are the advantages of the push-pull amplifier that many of us have at some time wondered whether it would not be a good plan to have the amplifier that was push-pull throughout, without any single-ended stages, and without any phase inverter. There seems little doubt that such an arrangement, provided it were well balanced, would have considerable advantage. Indeed, the way is shown by some of the best audio amplifier circuits in existence, such as the Williamson, which has a push-pull voltage amplifier stage directly in front of the power amplifier stage, so that as much of the amplification shall be of the push-pull, or balanced variety. Making an amplifier push-pull throughout is only one or two steps further along this same road, and the practical question is, can it be done?

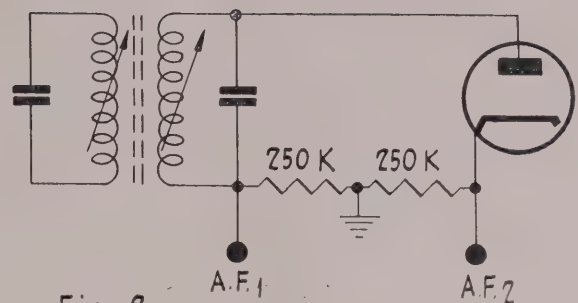


BROADCASTING PRACTICE

It is quite common in broadcasting practice to have an amplifier which is balanced from beginning to end, but in these cases, there is a phase inverting circuit, which usually consists of a push-pull input transformer which in addition, steps up the signal voltage from a low-impedance line. Of course, this sort of thing is not what we mean here. If we eliminate the phase inverter, our all-push-pull amplifier will have two input terminals instead of the more usual one, and we will still be faced with the problem of providing push-pull input voltages. In some instances, this can be done quite easily. Some pickups, for example can be made to provide equal and out-of-phase voltages, suitable for applying to the grids of a push-pull amplifier, simply by allowing the coil to remain ungrounded, and feeding one end of the winding to each push-pull grid. But more of that anon. This month's Circuit for the Experimenter shows how the detector of a radio receiver may be made to give push-pull output voltages, so that it can feed the grids of an all-push-pull amplifier such as we have been discussing.

PUSH-PULL DETECTOR OUTPUT

The most commonly used ordinary detector circuit is shown in Fig. 1. Here, we have a 500k. detector load resistor, grounded at the end which connects to the cathode of the detector diode. In this case the diode current flows in the load in such a way as to develop a negative D.C. potential on the load resistor. The circuit is single-ended, having only one output terminal. The 50k. resistor and two 100mmfd. condensers serve as a filter to remove I.F. voltage



from the load resistor, and thus prevent it from being passed on to the audio amplifier. The load resistor is made a potentiometer, and this is used as the volume control for the receiver. Now if we removed the earth sign from its present position in Fig. 1, and placed it instead at the junction between the 50k. and 500k. resistors, the action of the circuit would be unchanged, in that it would still detect in exactly the same manner as before. The only difference would lie in the fact that now, a positive D.C. voltage would be developed on the load resistor rather than a negative one. This results simply from the fact that we have earthed the other end of the load resistor, while the current flows through it in the same direction as before.

Now we are not really interested in the polarity of the D.C. voltage developed on the load resistor, because the D.C. is a by-product of the detection, in which we are not usually interested, especially when we use a separate diode for obtaining A.V.C. We have emphasized it, however, because it illustrates the fact that by altering the earth point of the circuit, we can easily obtain signals in opposite polarity to those given by the normal connection. What happens, therefore, if we earth the load resistor at some point other than either end? This is illustrated in Fig. 2. We have omitted R.F. filtering, for the sake of simplicity, and we have indicated that the load resistor has been earthed at its mid-point. Now the D.C. from the detector still flows round the circuit in the same old direction, but we will find that the cathodes of the rectifier will be positive with respect to earth, while the other end of the load resistor will be negative. Since the halves of the resistor are equal, and since the same current flows through both of them, the negative and positive output voltages will also be equal.

What we have illustrated by means of the D.C. will be equally true for the alternating, or audio components of current that also flow through the load resistor. Thus, at the two output terminals shown, there will appear equal audio voltages, exactly out of phase with each other. In other words, we have push-pull output from the detector, and if we like, we can feed the two outputs to the grids of a push-pull amplifier.

VOLUME CONTROL

There is only one drawback to the scheme outlined above. It is that it does not provide for control

(Continued on page 30.)

The PHILIPS Experimenter

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A V.H.F. POWER METER

As previous parts have given readers some idea of the properties and characteristics of Philips N.T.C. resistors, we feel it will be appropriate to close this short series of articles with a description of a practical piece of equipment making use of them. Appropriately enough, too, a radio application has been chosen which should appeal not only to those concerned with the professional aspects of V.H.F. communication, but also to amateur transmitters.

We should explain, perhaps, why it is that the power meter described in this article has been arranged specifically for V.H.F. work. There are two reasons. In the first place, other methods of power measurement are more readily applied at lower frequencies, and present few technical difficulties. Secondly, it will have been noted from the last part of this article that NTC resistors are not made in sizes that are capable of dissipating a great many watts. In the scheme used, the whole of the R.F. power to be measured is dissipated in the N.T.C. resistors used as the dummy load, so that unless several of them are used in series or parallel, it would not be possible to measure power of the order of 20 watts or more. At V.H.F., however, this is a relatively minor disadvantage, since the bulk of possible requirements are met by transmitter powers of under eight watts. Accordingly, the unit described uses two Philips N.T.C. resistors in parallel, and is thus able to measure maximum powers of the order of six to eight watts. At the same time, accurate results may be obtained on power as small as half a watt. In particular, those who are concerned about transmitter powers within this range need to have some ready method of checking output, since reduced power, through any fault whatever can sometimes be serious in such cases. Of course, there is no fundamental reason, apart from expense, why more than two resistors should not be used for measuring higher outputs. The arrangement is very simple to re-design for higher powers, as we hope succeeding paragraphs will show.

SCHEME OF THE POWER METER

The meter uses the principle, based on the properties of N.T.C. resistors, that if these are used as a dummy load, the R.F. power being dissipated in them can be estimated by measuring their D.C. resistance. The basis of this idea is that the resistance of the variable resistor depends solely on its temperature. It does not matter at all how that temperature is raised, whether by D.C., low-frequency A.C., or R.F.,

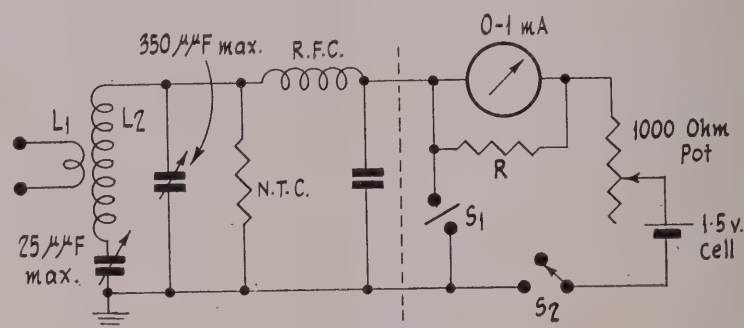


Fig. 1.—Circuit of the power meter. For the six-metre band, L_2 has 11 turns of 16g. tinned copper wire, double spaced, and $\frac{1}{2}$ in. in diameter. L_1 is a two-turn link which can be permanently or temporarily coupled to L_2 . R is a shunt equal to the resistance of the meter, so that the latter reads 2 ma. full scale.

the temperature is always a measure of the power passing through it. And since there is a definite relationship between its temperature and its D.C. resistance, the latter can be interpreted in terms of the R.F. power. It is true that for accurate results, the resistor will need to be calibrated, but this can be done using either low-frequency A.C., or even D.C. as the source of heat. With either, we can accurately measure the power in the resistor, and the same measurements will tell us its resistance. The usefulness of the resistor as a power measuring device for high radio frequencies, therefore lies in the fact that by its use, we are relieved of the responsibility of taking direct measurements of R.F. current voltage or resistance. In using the N.T.C. resistor the way we do, the only assumption made is that a given amount of R.F. power heats the resistor to the same temperature as does the same amount of A.C. or D.C. power. For frequencies up to several hundred megacycles per second, this assumption is perfectly valid.

Thus, the power meter consists of three parts. First of all there is a tuning and matching circuit. Its job is to take the output of the transmitter, and feed it into the dummy load in such a way that the latter becomes properly matched to the final amplifier, and so dissipates all the power the latter is capable of producing. The second part is the N.T.C. resistor itself, which is the dummy load, and the third part is the circuit which enables its resistance to be measured while it is actually loading the transmitter and dissipating its power output. Between the re-

sistor and the resistance-measuring circuit there is an R.F. filter, whose job it is to see that none of the R.F. finds its way into the resistance meter instead of into the load. Should some of the power do this, it will obviously not be counted in the measuring process, and the reading will be low.

THE MATCHING CIRCUIT

This consists of a coupling loop, L_1 , tightly coupled to a tuned circuit, comprising L_2 , and the two variable resistors. The arrangement of this circuit is that of a pi-section filter, which within wide limits is able to couple power most efficiently into anything from a high to a low value of load resistance. This is essential if the scheme is to work, because when the power is small, the resistance of the load will be high, while at the maximum power input that can be permitted, it will be only 100 ohms, or even less. The pi-coupler is perhaps the most versatile wide-range coupling circuit available, and provided it is made from high-Q components, its own losses will be small, and it will detract very little from the accuracy of measurement. In actual practice, the R.F. losses in the coupling circuit will be approximately the same as the resistance losses in the aerial system, so that the measured power will agree quite closely with that actually radiated by an aerial.

The resistors chosen for the load are type 83910/4K, and two of them are used in parallel. Using the lower values in this way ensures that the upper limit of resistance is not too high, and enables us to predict with some certainty the values that will be needed at any frequency for the two variables. The effective resistance across the whole tuned circuit is likely at all times to be greater than 2000 ohms, so that it is obvious that to obtain a match to the N.T.C. resistor, this will need to be connected across the larger of the two condensers. In order to match resistances of 2000 ohms downwards, the resistor will need to be tapped down the capacitive voltage divider formed by the variable condensers. Thus as long as the minimum capacity of the larger one is not too great, it is always possible to effect a match, by proper adjustment of the ratio of the two capacities. The terminals of the larger variable are thus the output terminals of the matching circuit, and the load is therefore permanently connected across them.

The R.F. filter comprises the R.F. choke, and the fixed condenser. Since one end of the load resistor goes to ground, one side of the resistance-measuring circuit can also be connected there. The other end goes to the free end of the R.F. choke.

It will be seen that the measuring circuit is that of a conventional ohm-meter. This is not the most accurate, but it is certainly the simplest and most convenient way of measuring the resistance of the load. However, if greater accuracy is required, there is no reason why a suitable bridge should not be used. It would usually be necessary though, to make a bridge specially for the job, and build it in as part of the finished article. Since the meter was designed with the idea of illustrating the possibilities, rather than realising the utmost inaccuracy, the original equipment constructed in our laboratory used the simple ohm-meter circuit shown in the diagram.

CONSTRUCTION

The only critical part of the construction is the putting together of the matching circuit. Here it is

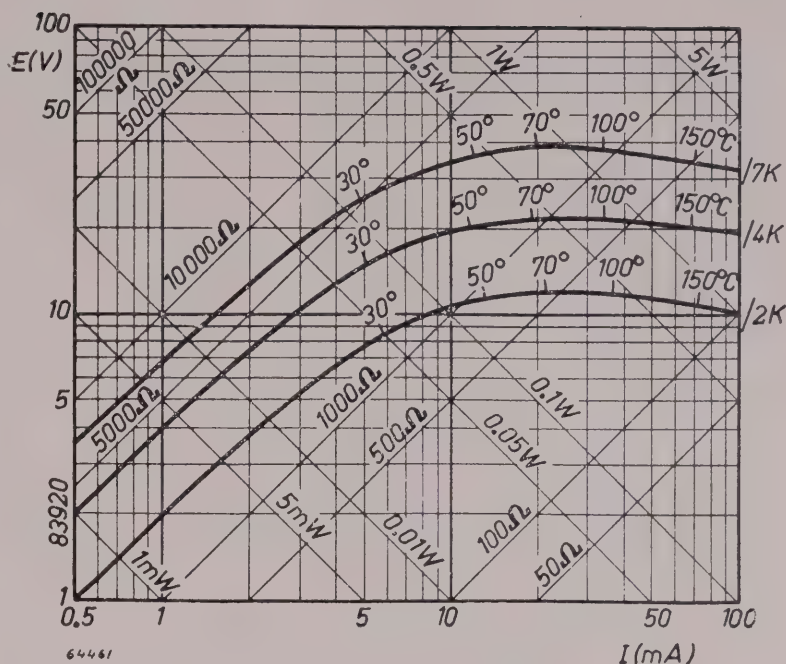
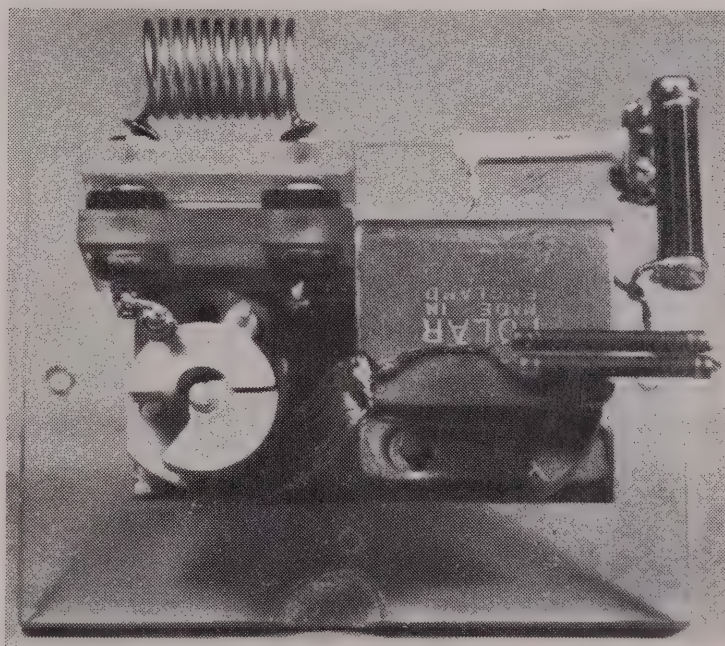


Fig. 2.



Showing the construction of the matching circuit, load, and R.F. filter.

essential to keep the losses as small as possible, and the construction shown in the photograph ensures this. Both variable condensers are mounted on a copper plate which in turn is bolted to a piece of polystyrene sheet. The earthy ends of the condensers are firmly bonded together by a piece of heavy braid, so that complete reliance is not placed on the tightness of the mounting screws for bonding the circuit together. The coil is made into a pair of banana sockets mounted on polystyrene, in such a position that leads in the R.F. circuit are kept very short indeed. In this way it will be found possible to use the meter at frequencies at least as high as 144 mc/sec., by arranging for plug-in coils; the one shown in the photograph is the six-metre coil. The parallel NTC resistors can be seen in the right-hand

(Continued on page 30.)

PUSH-PULL WITHOUT PHASE INVERTERS

(Continued from Page 27.)

over the amplifier of the signals fed to the grids of the push-pull amplifier stage. In simpler terms, no volume control. This does not mean that it cannot be done, however. By using ganged potentiometers, with the moving arms each feeding one grid, we can arrange that irrespective of amplitude, the outputs will still remain balanced in amplitude. The only difficulty rests in obtaining ganged controls. These were to be found in certain war-time radar equipments, and might be available in small quantities on the surplus market. However, the best way of obtaining them would be to ask your local radio parts dealer to get one of his suppliers of potentiometers to obtain one for you. The point is that most manufacturers of controls do make ganged controls, but the market for them here is so small that very few are imported. "Radio and Electronics" has been able to procure small quantities of special controls like this for use in our own laboratory. Of course in Britain and America, such components are commonplace.

A COMPLETE CIRCUIT

A complete circuit for a detector with push-pull output is shown in Fig. 3. It will be seen that not only is the load resistor split into halves, but so is the I.F. filter too. One possible objection to the circuit might be that with the diode's cathodes above ground, a certain amount of hum may appear in the output. In the average receiver, however, this is unlikely to be noticeable, since the detector output is usually several volts on a reasonably strong signal, while the hum is unlikely to be stronger than a few millivolts.

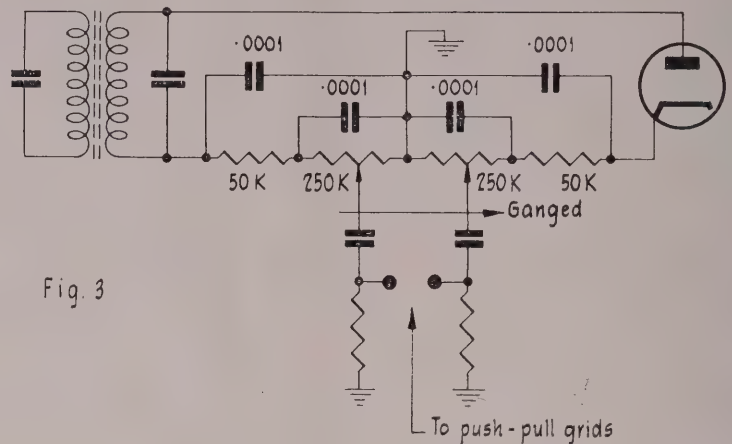


Fig. 3

MAKING GANGED POTENTIOMETERS

Even if ganged potentiometers are not obtainable at any price, the persistent experimenter will not exclude the possibility of his ganging a pair of identical potentiometers himself. This could be done either by suitable gearing, or by using drum-and-cord drives. Should this be attempted, it is important to remember that potentiometers used as volume controls are not linear. That is to say, if the two are to be adjusted to the same resistance value by the same amount of rotation, they *must* be turned in the same direction, and any gearing scheme that turns them simultaneously in opposite directions will not work, because of the different amounts of resistance change per degree of rotation at opposite ends of the potentiometer.

In another article of this series, we will have something to say about feeding the all-push-pull amplifier from gramophone pick-ups.

New High-Power Transmitter Opened In Middle East

Now in operation at Abu Zaabal, near Cairo, a new short-wave broadcasting transmitter, the most powerful of its kind in the Middle East, is intended as the "voice" of all Arab-speaking countries. It was designed, manufactured and installed by Marconi's Wireless Telegraph Co. Ltd., who erected the first major broadcasting transmitter in Egypt—more than 20 years ago—and who have recently supplied all equipment for the extension of broadcasting in Upper Egypt.

This 100-kilowatt short-wave transmitter, together with a 100-kilowatt medium-wave transmitter with aerial systems, now under construction by the company at the same site, should provide world-wide and local coverage for the Arabs.

In both transmitters the valves are air-cooled. This same technique is being used in the Third Programme transmitters installed for the B.B.C. at Daventry, and is far more efficient and economical than the water-cooling method.

The short-wave transmitter operates on six frequencies, and is so designed that rapid selection of any one frequency can be carried out in less than three minutes.

Masts for the medium-wave aerial system are each 680 ft. high—200 ft. higher than the Great Pyramid—and each weighs about 70 tons. The base of each mast

rests on a ball of only 7.5 cm. diameter, which acts as a pivot allowing the mast a certain amount of sway.

PHILIPS EXPERIMENTER No. 78

(Continued from page 29.)

front corner, soldered by their leads as directly as possible to the output condenser. The parts of the R.F. filter can also be seen. Since the measuring circuit is purely a D.C. one, there is nothing critical about the lay-out of its parts, and this can be left to the individual constructor. There is no reason, for example, why the power meter should include its own ohm-meter circuit, since an external one can quite easily be used. The poly panel with the matching circuit, load resistor and filter can best be mounted an inch or two from a metal chassis, with extension shafts (insulating preferably) brought through to the control knobs. If the measuring circuit is built in, its parts, including the meter can be mounted directly on the chassis, but if it is intended to use an external metering circuit, pin jacks for the leads will be all that is needed.

(To be concluded.)

Millimeter Waves—The New Frontier in Radio

By the Engineering Department, Aerovox Corporation

Since the earliest days of radio, the exploration of frequencies higher than those in common use at the time has provided an exciting field of endeavour for the scientist and experimenter with pioneering instincts. Strangely enough, such efforts have almost invariably been ridiculed and condemned to failure by the contemporaries of such "explorers". And, just as unfailingly, the ultimate results have usually proven the sceptics to be wrong and the new portion of the radio frequency spectrum has always turned out to be of extreme value in extending the art of radio communication.

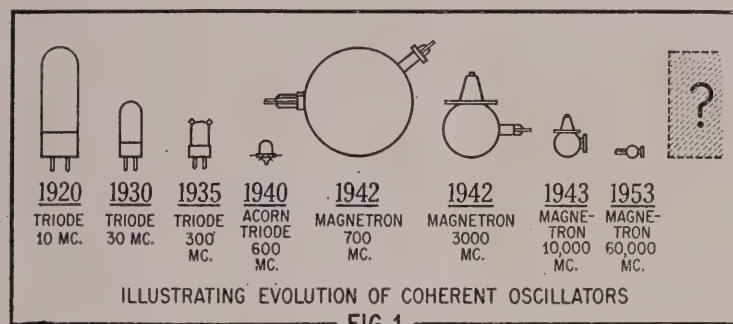


FIG. 1

Even before World War I, in the days of spark transmission, the radio amateur fraternity were relegated to the region "200 meters and down" because this portion of the spectrum was considered virtually worthless for communication purposes by the professional engineering world. However, when the "hams" demonstrated that trans-oceanic contacts were easily accomplished on the unheard-of wavelength of 100 metres, these same commercial interests flocked to use the new "short waves". Needless to say, this region now contains almost all of the valuable communications channels now in use.

The adventurous experimenters didn't stop at 100 metres, or even 50 metres, however. They pushed the revolutionary new vacuum tube oscillators and receivers all the way down to about 20 metres. Again, this "radio no-man's-land," which had been thought to be worthless, had, in a short time, demonstrated a new phenomenon in communication—long distance signals over a daylight path. This started another rush for new channels, and today these frequencies are highly prized for international broadcasting and communication.

This downward migration, spearheaded by the amateur and experimenter, ground to a halt below 10 metres, where it was found that radio signals were not reflected back to the earth by the ionosphere much of the time, making communications beyond the horizon doubtful. For a long while these line-of-sight V.H.F. frequencies remained unexploited because of these limited propagation characteristics and the fact that conventional vacuum tubes of that era would not operate efficiently at such elevated frequencies. Transit-time effects, excessive lead inductance, and high losses in the base materials used limited their performance. Little effort was expended in developing improved tubes and circuits since few people had enough vision to see that such short-haul radio might be extremely valuable for local services like police radio, where the line-of-sight characteristic would give freedom from interference by similar services in distant cities.

Here again, however, a few intrepid experimenters, with an eye on the vast reaches of unusual megacycles

stretching into the V.H.F. region, persevered. They removed the lossy bakelite bases from the available tubes, and developed "long-lines" circuits to minimize the effects of tube element loading. They spent long hours policing unused frequencies looking for someone with whom to communicate. They learned to make multi-element, high-gain antenna arrays compensate for the low powers available from the tubes at hand. Even as late as 1940, a "ham" experimenter engaged in such pursuits was likely to be considered more than slightly demented by his fellow amateurs, who maintained that he

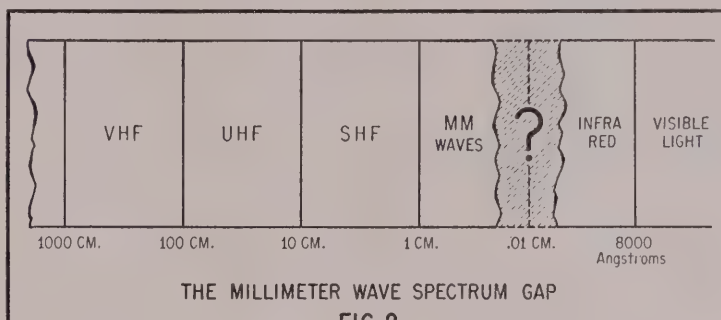


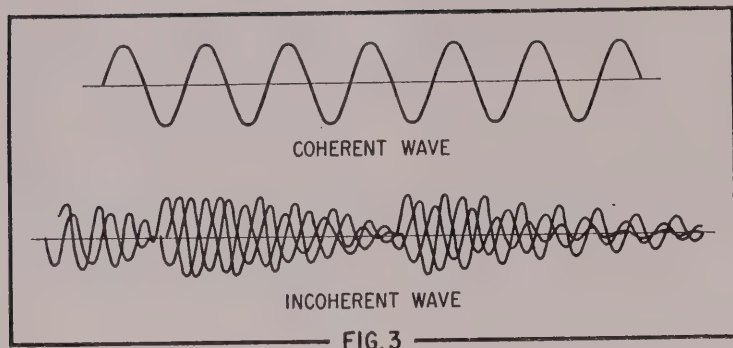
FIG. 2

was wasting his time with "back-yard" radio when he could communicate across the world by going a few megacycles lower.

In the end, however, these "die-hard" experimenters had pioneered the V.H.F. bands and had laid the groundwork for the techniques now employed in the transmission and reception of television, F.M., police radio and many other services. These frequencies now include the most commercially important megacycles in the entire radio frequency spectrum.

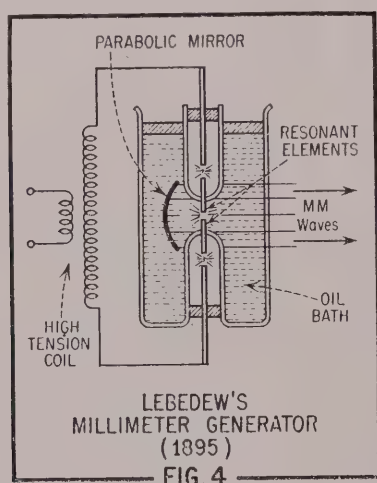
Unquestionably, the most rapid advance in the exploration of the spectrum was made during the period of World War II, when the upper limit of efficient radio frequency generation was extended at least 100 times in a few short years. The impetus, of course, was the development of radar. At the start of this period, the conventional triode had reached its limit of practicality at about 600 megacycles. From the early "audion" it had been "scaled down" to the size of the familiar acorn tube. This reduction in size was necessary to keep inter-electrode capacitances small so that the external circuit would not be reduced to a short between the grid and plate. It was also necessary to space the tube elements extremely close to reduce transit time effects. The result of this size scaling is to greatly reduce the power generating capabilities of the tube, since the small electrodes can only dissipate a small amount of heat.

The need for a source of powerful centimetre waves for radar led to the development of the microwave magnetron and klystron tubes. These made the extension of the state of the art mentioned above possible because, unlike the triode, their dimensions are comparable to the wavelengths generated. Thus, a magnetron for 600 megacycles was many times larger than a triode for the same frequency and could dissipate proportionally more power. However, as the microwave tubes have been scaled to progressively higher frequencies, the size of their critical elements has decreased accordingly. The result is that the magnetron and klystron have encountered, at around 60,000 megacycles, the same kind of limitations reached



by the triode in the thirties. Their size and element tolerances and spacings have become comparable to the acorn tube—and their power handling capabilities not much better.

The evolution of radio frequency generators discussed above is illustrated in Fig. 1, which shows relative size comparisons. It is obvious from this presentation that a new principle is needed to extend the useful limit of generation further into the millimetre wave section. Scientists and physicists interested in spanning the gap which exists between the long infra-red part of the spectrum and the radio frequency portion (see Fig. 2) have long sought this new principle. Figure 1 indicates that a successful generator for the millimetre wavelengths will probably have to be much larger in dimensions, compared with the waves generated, than the magnetron and klystron are. To date, the approaches used in the generation of such extremely short waves have had this property. We will now discuss some of these.



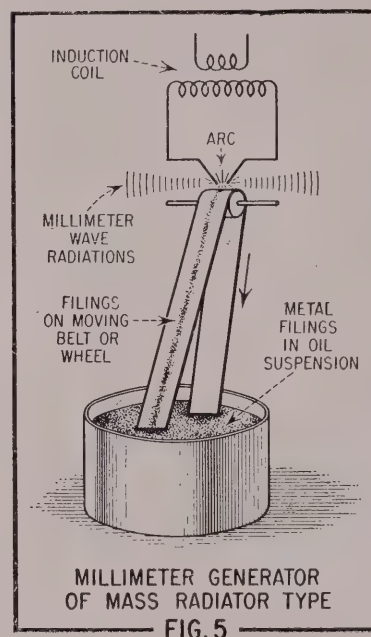
INCOHERENT GENERATORS

Most of the radio frequency sources, except the early spark transmitters, are *coherent* generators. A coherent generator is one which emits a wave train having a single (or *monochromatic*) frequency of a single and sinusoidally varying phase. An *incoherent* source, on the other hand, is one which emits energy over a band of frequencies consisting of numerous wave trains of various phases and amplitudes. Wave trains of these two types are compared in Fig. 3. Examples of incoherent sources are hot bodies which emit visible light or infra-red waves, and the spark transmitters mentioned above.

The type of generator employed in attempts to span the gap between light waves and radio waves in the past has usually depended upon the background of the researcher. Physicists, trying to extend the long wavelength limits of their light sources for spectroscopy, have pushed into the long infra-red region with inco-

herent generators, while engineers have scaled coherent oscillators down to a few millimetres from the radio side.

The first successful millimetre generators were incoherent sources utilizing the spark discharge principle. These were essentially scaled-down versions of the early long-wave spark transmitters, which consisted of a resonant circuit excited by a spark discharge. It will be recalled that a circuit of this kind generates a "damped" wave because the spark *shock-excites* the resonant circuit which then oscillates until the circuit losses cause the oscillator to die out, or *decay*. A good example of a millimetre source using this principle is *Lebedew's* generator, built in 1895. See Fig. 4. In this simple arrangement, a spark discharge produced by a high-tension induction coil is passed through a gap between two resonant



elements immersed in an oil bath. A parabolic mirror focuses the oscillatory energy thus produced in the desired direction. The oil bath serves to cool the resonant elements. The wavelength generated is determined by the physical size of the spark-gap elements; incoherent waves as short as .22 millimetre have been generated by this method.

A similar form of incoherent millimetre wave generator has been known since the early 1920's. This machine, classified as a *mass radiator*, is illustrated in Fig. 5. It consists of a sort of conveyor belt which carries metal filings suspended in oil from a reservoir up through a spark gap where a high-tension spark is passed through them. Here again, the mechanism is similar to that of the old spark transmitter and is closely related to Lebedew's generator, except that the spark is passed through a large number of metallic particles which radiate at the same time. The radiations produced are far from monochromatic because of differing metallic particle sizes and the inherently low "Q" of the radiators. This renders the mass radiator inadequate for the purposes of spectroscopy required by physicists since the large spread in frequency reduces the resolving power of the instrument.

More recent attempts to generate millimetre waves by incoherent means have consisted of impinging charged ball-bearings or atomized mercury droplets on a metal plate, and similar schemes. All such methods suffer from low power generating ability, frequency dispersion, and

difficulty in utilizing the energy because it is radiated in all directions.

COHERENT MILLIMETRE GENERATORS

To date, the only successful coherent millimetre wave generators are scaled-down versions of the magnetron and klystron. As discussed above, both of these are approaching their ultimate limits a little below 5 millimetres wavelength. Here the efficiency of the magnetron, normally of the order of 50 per cent. in the centimetre range, has fallen to only a few per cent. and that of the klystron is much lower. The powers available are only a few kilowatts pulsed or a few milliwatts continuous wave. The prospects of reaching substantially shorter wavelengths are remote. New principles will have to be evolved.

Many of the new devices which have been proposed for millimetre wave generation are cloaked in military security. Most are so large compared with the wavelength generated and so inefficient as to make practical usage outside of the laboratory highly improbable. One reason for the ponderous size of some of these schemes is the dependence upon "relativistic" electrons, i.e., electrons accelerated to velocities near that of light. Equipment to achieve such velocities is inherently complex and cumbersome.

The question naturally arises as to what possible applications millimetre waves might be put when practically achieved. *To question the ultimate utility of this portion of the spectrum is probably just as fallacious as it was in 1920 to think that all wavelengths below 200 metres are worthless.* If history again repeats, this portion of the radio frequency spectrum should become as important to the art of communication as any which preceded it.

It is true that waves of this length are difficult to generate, transmission lines to handle them are critical, and high absorption occurs in the atmosphere to make even line-of-sight transmission marginal. However, once the first two of these shortcomings are overcome, the last may even become an advantage. The limitation to very short ranges in the free atmosphere might make highly personalized forms of radio communication possible. Also, because of the small size of the waveguides associated with millimetre waves, long distance communications through evacuated or gas-filled waveguides consisting virtually of "hollow wires" would become possible. Because of the large bandwidth carried by such transmission lines, a single one would be capable of simultaneously carrying thousands of voice communication channels or hundreds of six-megacycle television channels.

The Redifon Sabre Flight Simulator

The development of the electronic flight simulator as an aid to pilot training has been the most significant advance in technique since the war.

It is being increasingly adopted by civil airlines and for military purposes.

The type F.86E. simulator consists, basically of a replica of the Sabre cockpit with every instrument and control exactly reproduced, together with control panels and recorders for the instructor. The computing equipment is housed in a trailer and has an independent mobile power generator.

Practically any navigational problem or emergency condition can be presented to the trainee pilot. These problems and the normal conditions of flight are translated by an analogue computer consisting of an elaborate system of electronic and electro-mechanical apparatus into instrument readings and control responses.

The pilot's handling of the controls and equipment produces the same results in the flight simulator as would be experienced in an actual aircraft—without any of the hazard and at a fraction of the cost of actual flight.

It is thus possible to feed emergency conditions into the simulator—conditions, which, with a student pilot, in the air, easily might lead to disaster. Such things as instrument or engine failures can be introduced and repeated at will until the instructor is satisfied that the trainee's actions are immediate and correct.

Appropriate aural effects and correct feel of all controls are examples of the faithfulness of simulations. In fact, the only impressions which are not given are the physical effect of acceleration and the external view through the canopy—impressions which cause no disadvantage by their absence now that pilots no longer fly "by the seat of their pants," but by instruments.

When the flight simulator is in operation, signals originating from the controls are fed through valve amplifiers to actuate a number of interconnected electro-mechanical servo units which form the analogue computers.

The servo units are reversible motor-driven integrators or position controlled devices carrying assemblies of potentiometers, with windings contoured to produce various voltage functions. The voltages are combined to interrelate the computing servos and thereby solve the appropriate equations. Every movement of the elevator, ailerons, flaps, rudder and throttle is translated into the reading of the airspeed, rate of climb, rate of turn,

pitch and roll instruments in the cockpit. Throttle adjustment results in appropriate variations in the simulated engine noises which also vary with airspeed. Gunfire and brake squeal are examples of other noises generated.

A large number of failures and effects can be fed in from the instructor's console, including fires in various zones of the aircraft; failure of supplies; flight instrument failures; hydraulic failures; undercarriage faults and errors in all engine and fuel system instruments. The radio aids equipment on the console and the two recorders give full operation—including failures and deficiencies—of the radio facilities. Each aid is independently adjustable for different transmitter locations.

The large area recorder produces D.F. facilities and is electrically coupled to the small area unit automatically to switch in the small area charts at appropriate points.

In the design of the Sabre Flight Simulator, Redifon Ltd. of England have used the characteristics of the actual aircraft and its power plant in their calculations. The supply of accurate data is a prime necessity for correct simulation.

The Simulator is, in essence, a habit forming machine on which a trainee with basic experience is able to become familiar with a new aircraft. Through correction and repetition he is taught to react instinctively and in the right way when presented with flight and navigational problems. Thus, when the trainee has completed his course on the simulator only a few hours are required for take-off and landing practice and to confirm the lessons he learned on the ground.

The Flight Simulator serves an additional purpose; periodic checks on Sabre pilots can now be carried out on the simulator far more thoroughly than is possible in the air.

It is at once apparent that simulator training avoids loss of training time through bad weather conditions. In addition the duration of each period of simulator training is independent of fuel consumption considerations; it can be continuous and progressive throughout.

It reduces the number of instructional aircraft required and can, when necessary, be used to familiarise pilots before the actual aircraft are available—a factor which may have very important strategical considerations.

The hourly operating cost of the Sabre Flight Simulator is 8 dollars against 145 dollars for the aircraft, while maintenance costs compared with those of one instructional aircraft are so small as to be almost negligible.

SHOES and SHIPS

*"The time has come," the Walrus said
"To talk of many things. . . ."*

By Special Arrangement with the Walrus

AFTER THE PARTY

Now that the Industrial Fair at Wellington is over and the fun and games are finished, the worth of television can be assessed, for, undoubtedly, it was a TV Show!

Recent years have brought more and more of these television demonstrations to New Zealand. All have been most interesting. This time, however, the public was given an opportunity to see organized programmes broadcast (or should we say "telecast"?) at regular times, and with full camera and control equipment, thus ensuring continuity of programme.

By virtue of the fact that, this time, radio transmission was used, the service was received over a wide area. As British standards were adopted for the transmission, Wellington radio establishments having standard TV sets available were able to provide the public with more opportunities to become familiar with this new medium.

Indeed, some of us were fortunate enough to have sets in our own homes, and it was here that TV really showed its worth. As one of the lucky ones, the "Walrus" is able to vouch for the terrific impact made by this form of entertainment. From the comfort of one's armchair, it is an asset to both watch and hear the artists perform. Adding to the enjoyment is the ability of the TV camera to provide views of the artist normally quite unobtainable by the average person in an audience. For instance, as well as giving a full view of a pianist, the camera can also show only the hands and keyboard at close range, and then present a variety of views from different angles. Similarly, dancers can be seen close up in full length, then feet only, and finally there may be perhaps a full stage view. Indeed, the possibilities are considerable.

The engineers with the equipment in Wellington also showed us some interesting variations, whereby the outputs of three cameras were combined to form a kaleidoscope picture of, say, several different members of an orchestra superimposed upon each other—a picture full of movement and most suggestive of rhythm and action.

To a large extent, this demonstration has laid one of the bogies surrounding TV—namely, that Wellington would be a difficult city to cover with good signal strength. The transmitter in use was rated at 25 watts peak power—a very low figure indeed—yet good pictures were received in homes in many suburbs. In the Hutt Valley area, some ten miles from Wellington, the "Walrus" received pictures with quite fair entertainment value. The worst feature of low signal strength is that noise and interference from other transmissions become annoying. However, it seems that the modern TV set is quite sensitive and will lock readily to even relatively weak signals, particularly where the modern form of automatic picture locking (or frequency control) is employed.

It seems possible that a vision transmitter of one or two kilowatts power, sited on a commanding

position in Wellington, would provide excellent coverage over quite a wide area.

Many contend that the supply of programme material is the bugbear of TV, and there is no doubt that this medium makes considerable demands on talent. Unlike the cinema, every evening has to have a change of programme. For obvious reasons, the same show cannot go on for a whole week! However, canned or film programmes are more readily available now from overseas, and these occupy in TV the place of the record in ordinary broadcasting. For local talent, TV presents an undreamed-of opportunity to aspiring artists. Already, from the modest programmes broadcast at the demonstration, a number of performers have proved their very real TV appeal. Essentially, television is a medium for movement, and, if programmes are to maintain interest, plenty of movement must be cultivated. New Zealand's own Maori concerts, with all their movement and sparkle, provide particularly good viewing, as those who saw the telecast of the Ngati-Poneke Maori concert will affirm.

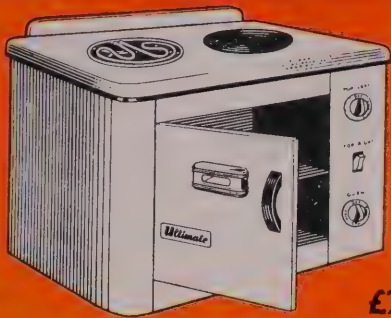
To a large extent, the public have been sadly misinformed about television. Strangely enough, many people have been surprised to find that sound is included in telecasts, as they had expected the picture to be silent. Others, again, believe that, if TV is just around the corner, it would be unwise to buy a radio set. The latter, however, would still be necessary for the reception of normal radio broadcasts, as TV supplements sound, but does not replace it.

Quite contrary to the general opinion, it looks as though the cost of ordinary TV receivers will not be unduly high, as it is now estimated that a good TV set should be obtainable for about £80. Of course, there are bound to be bigger and more elaborate ones in impressive cabinets, which will cost substantially more, but, in the main, the table model set with a tube of 14in. or so should prove most popular.

Quite erroneously, many people subscribe to the theory that, as yet, TV is only in the developmental stage and that big improvements are yet to come. No doubt this fact is influencing the Government in its wait-and-see policy. However, such a supposition is not true. Now that the transmission of pictures is a long-established fact, improvements will come slowly and painstakingly, and are not likely to revolutionize the whole system over-night. The answer to it all is found in Britain's attitude towards TV. During the war the service was discontinued, and was not recommenced until some years after the end of the war. Thus, there was a golden opportunity to throw the whole lot into the melting pot and re-establish the service with new methods and techniques. However, after considerable research into the problem, that sober, cautious-thinking body, the B.B.C., did not consider that sufficiently worthwhile reasons had been advanced to warrant its introducing a change. Consequently it proceeded with its very big

(Continued on page 49.)

ELECTRICAL AND TRADE SECTION



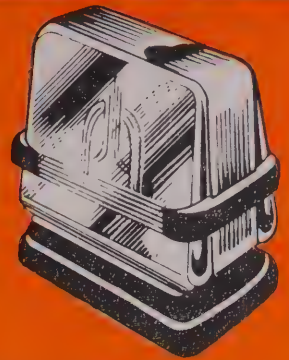
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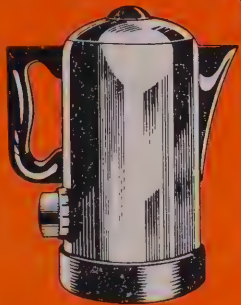
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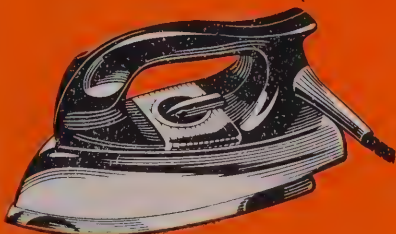
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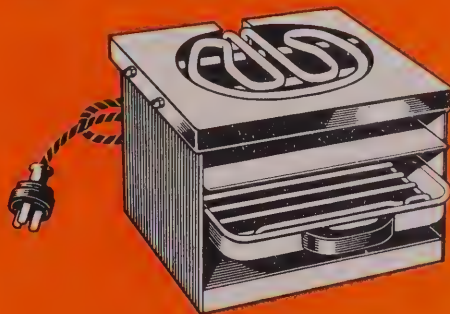
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QUAY STREET, AUCKLAND



Nowadays one can hardly imagine how life would be without artificial light, not only for general utility purposes but also for special purposes. We only have to think, for instance, of how in the olden times the navigators of ships at sea had to rely upon beacon fires to make a safe passage along the coast.

With the invention of the electric lamp all this was changed and great possibilities were opened in many directions. The drawn tungsten wire filament followed by the coiled-coil filament, and finally the gas-discharge lamp led to an enormous increase in the number of purposes to which this form of artificial light could be put. Hand in hand with the development of optical systems, special lamps were made for them, so that at the present day we find thousands of different lamps being made for all sorts of purposes, from lighthouse lamps to lamps for gastroscopic examination.

It goes without saying that not only the visible part of the spectrum but also the invisible part has been investigated, namely the infra-red and the ultra-violet rays, for the use of which special lamps have been made for various purposes.

The importance of these special lamps will be realized when we try to imagine how it would be if our ships had no guiding beacons, our aircraft no navigating or landing light, our railways no signal lamps and automobiles no headlights. Then think, too, how necessary good lighting is for our surgeons. The development of all sorts of special lamps would fill pages of interesting history.

PHOTOGRAPHY

It is not so very many years ago that it was possible to photograph only by daylight. The professional photographers had to have specially built studios and the amateur could get good results only when the weather was fine and sunny. Now, thanks to the development of a series of photographic lamps, good

photographs can be taken under any conditions, indoors as well as outdoors, whilst with dark-room lamps negatives can be easily developed and prints made, to say nothing of the special lamps for making enlargements. For each of these lamps the colour of the light has been very carefully chosen to match the sensitivity of the photographic materials.

Press photography has been revolutionized by the use of "Photoflux" lamps. These flashlamps, which are being turned out in millions, are also being used more and more by amateur photographers, even in daylight, so as to be independent of the time of day, angle of incidence of the light, etc. For dark-room developing of negatives lamps are used which radiate a special colour of light for which the material is least sensitive. Other special lamps have been developed by means of which enlargements can be made quickly and efficiently. Undoubtedly the development of all these photographic lamps has contributed a great deal towards the progress made in the art of photography during the last twenty years.

THE FILM INDUSTRY

In filming, thousands of lamps of all possible kinds are used, both for the general lighting of the scene and for the effects, without which neither the black-and-white nor the technicolor film could be produced with such success. They are all great assets for creating the desired atmosphere of the scene being filmed.

For the projection of films, too, there are various kinds of special lamps giving the highest possible level of brightness of the picture for the minimum volume and the smallest possible area of the incandescent body. Even the sound track is recorded on the film and scanned during projection by means of artificial light.

TRAFFIC LIGHTING

Many different lamps are used nowadays in a modern automobile and each has a special purpose, as for instance the headlight lamps fitted with a metal dimming device to avoid blinding the drivers of passing cars. Then there are the lamps made for the direction indicators, the stop lamps etc.

Mention has been made already of our navigation light and the beacon lights for safe landing, the lamps for which all have to answer special requirements. Further there is the lighthouse lighting, each lighthouse having its own characteristic flashes so that navigators approaching the coast may determine their position exactly.

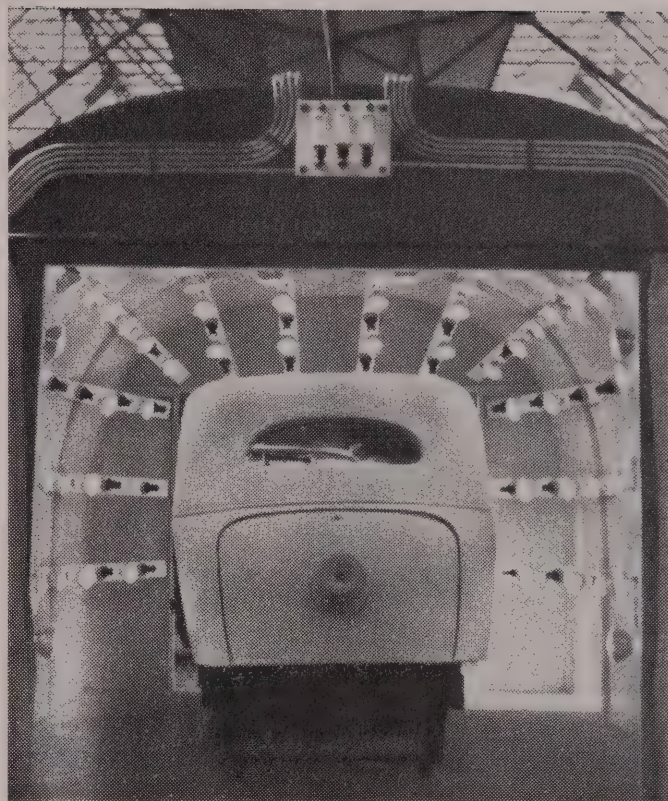
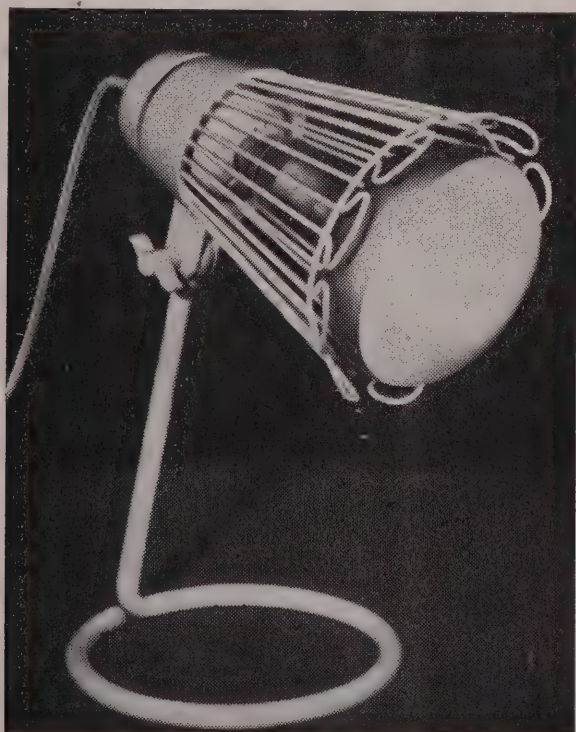
In a modern train one can sit in comfort and read a newspaper or book without giving a thought to the fact that one's safety depends upon the signals along the line, all of which are now on the electric system. Even when riding a bicycle—which has to be fitted with a headlight and a rear light—one probably never thinks how much work is expended on such small bulbs to ensure that the thin filament can withstand the high temperature at which it burns and all the vibrations to which it is exposed.

DECORATIVE LIGHTING

All special kinds of special lamps are also being used for decorative lighting: Christmas-tree candles, coloured lamps for garden fêtes, illuminated signs in the shopping centres of towns, etc. Looking into a modern shop-window one notices that, in addition to the normal lighting with TL lamps, various beam lights are used to lend more lustre to the goods displayed—"Attralux," Altrilux" and "Comptalux" lamps.

PILOT LAMPS

Pilot lamps, too, have their place in our daily life. The housewife would not feel at ease if the neon signal lamp on her electric cooking range did not light up when it should. The modern telephone exchange could not function without those thousands



of small lamps all having their special significance for the operators. And what would the dashboard of a motor car be without its pilot lamps. In fact there are an enormous number of applications of these signalling lamps, only a few examples of which have been given here as an indication of the importance of this branch of the trade in special lamps.

OTHER DEVELOPMENTS WITH SPECIAL LAMPS

In whatever direction one turns, it will be found that some work or other would be impossible without special lamps, or at least that the work has been simplified or made easier with them. Special lamps were designed for Professor Piccard's deep-sea explorations. Without mining lamps the miners could not work hundreds of feet below the earth's surface. The navigator of an aeroplane flying high at night would feel ill at ease if he had no light by which to watch his instruments.

The parts of the spectrum either side of the visible rays have likewise been explored in recent times. On the one side lie the infra-red rays, which have been put to use for industrial and medical purposes. The so-called drying lamps, specially designed so as to radiate rays of the right wavelength, save a great deal of time in drying processes in the majority of industries and also save a great deal of valuable space in the factories; as an example, in the automobile industry the time taken for drying the enamel has been reduced to about one-fifth. New applications for the drying lamp are being

Above: Infra-red lamps being used to speed up the drying of paint work on a motor-car body.

Left: An ultra-violet lamp intended for sun-tan treatment in the home.

Heading: A selection of photographic flash-bulbs.

(Continued on page 49.)

Trade Winds

THOUSANDS SHAVED AT THE SHOW

By popular vote, one of the most attractive exhibits at the Wellington Show was the Philips Philishave "12" demonstration stand. Praise was forthcoming from many quarters on the efficient organization maintained throughout the Show. More than 5,000 men received free shaving demonstrations dur-



WIM BOTZEN ignores the by-laws while using a battery-operated Philishave.

ing the 15-day period, while many thousands more took a lively interest in the working of the Philishave. Each demonstration Philishave performed the equivalent of eight years' normal use without a breakdown.

Six hostesses, specially trained for the job, coped with the rush of men. The pleasant task of supervising these young ladies was capably carried out by "Maurie" Harding, in conjunction with Philishave sales representative, Wim Botzen. Each man coming in for a shaving demonstration received a numbered ticket, and 15 men were lucky enough to hold the winning numbers entitling them to receive free one of the coveted Philishaves. All in all, the Philishave stand was an unqualified success. It served to prove the popularity of "live" stands at shows of this kind.

* * *

TOPOGRAPHICALLY NEW ZEALAND QUITE SUITABLE FOR TELEVISION

Contending that there is no technical reason whatsoever why we should not have TV in New Zealand, Mr. G. A. Wooller, managing director of Pye (New Zealand) Ltd., when speaking at Dunedin recently, pointed out that the argument that the topography of New Zealand would prohibit television is being overcome in a number of other countries.

He considered that a certain degree of sponsored TV might prove best for New Zealand in that, by this practice, the service would cost less to the public.

With home-loving New Zealanders with their limited number of outside interests in comparison with other countries, TV should prove most popular. As sport plays so great a part in our life, this field should provide the biggest portion of the programmes.

For this purpose, New Zealand's good light and remarkably clear atmosphere should prove ideal, Mr. Wooller said.

He also considered that the radio and television industry in this country is quite capable of building sets and there should be no need to import receivers, though, as with radio, it will be necessary to import parts for the receivers. The price of a 14-inch receiver suitable for New Zealand conditions is estimated to be about £75.

The wisdom of the recommendation to adopt the 405 line system in New Zealand was commended by Mr. Wooller, who remarked that, with such a system, a good picture could be obtained for a price much lower than that of any of the other standards. In addition, with the 405 system, it is possible to use ordinary telephone lines to relay television programmes up to a distance of three miles.

POSSIBILITY OF TV TESTS IN DUNEDIN

Dunedinites may soon view TV for themselves. Providing the equipment is not required in other overseas countries, Messrs. Pye (New Zealand) Ltd. hope to take at least two cameras and a number of different types of receivers to Dunedin shortly. These will be established in hospitals, radio shops and private homes in selected areas in and around the city to test the field strength of the transmitter.

The latter will have a power of 25 watts, and in spite of the hilly terrain should give excellent coverage. Normally, such a transmitter is used as an outside broadcast station to relay back to the studio.

We look forward to learning the reactions of the Scots to this fascinating new entertainment medium!

* * *

PHILIPS RECORD DEPARTMENT ESTABLISHED

Latest development in Philips Electrical Industries of New Zealand Ltd., is the opening of their Record Department under the direction of Mr. S. Vause, well-known throughout New Zealand's record industry and to readers of Radio and Electronics.

First release of Philips recording was scheduled for the end of February, and fresh supplies and new releases will be coming to hand at regular intervals. The New Zealand Philips Library is being drawn from the catalogues of Philips recording centres in Holland, Britain France and other European countries. It will also include, under a recently signed agreement, the complete list of Columbia Records Inc. of New York, for all recordings made after November 1952.

The library will embrace many of the world's outstanding artists including Guy Mitchell, Gracie Fields, Rosemary Clooney, Percy Faith and his Orchestra, Frankie Laine, Johnnie Ray, Liberace and Paul Weston and his Orchestra in the popular field, and the Amsterdam Concertgebouw-Orchestra, the Berlin Philharmonic Orchestra, Isaac Stern with the Royal Philharmonic Orchestra and the Phil-

harmonic Symphony Orchestra of New York in the classical field. The catalogue will eventually include long playing as well as standard 78 R.P.M. discs.

* * *



Mrs. Halliwell (above) and Patricia Ball receive their prizes from Angus McMillan.

WINNER OF PHILISHAVE SHOW COMPETITION PRESENTED WITH RADIOPLAYER

As part of their Show fare Philips ran an open-to-all slogan competition which entailed counting up the number of times the word Philishave appeared on the stand and on the entry form leaflet and writing a 10-word Philishave slogan. A large number of entries was received, the winning one being sent in by Mrs. L. Halliwell of Wellington. Mrs. Halliwell's prize, which was delivered to her personally by Angus "Mac" McMillan, was a Philips Radioplayer, Model 126.

After being photographed alongside her new radioplayer in the sittingroom of her Northland home, Mrs. Halliwell expressed surprise at her good fortune and thanked Philips for their generous prize. She was told that her slogan was the most original and appropriate received.

The second prize winner was a young lass named Miss Patricia Ball of the neighbouring suburb of Khandallah. When confronted with her prize of a

Double Header Philishave electric shaver, the 12-year-old schoolgirl was at a loss to know what to do with her unexpected gift. Eventually she hit on the obvious solution—give the Philishave to daddy.

* * *

PYE DEMONSTRATIONS HELP NEW ZEALAND'S TV INSTRUCTORS

Enthusiastic helpers at the recent Pye TV Demonstrations at the Wellington Industrial Fair were Ron Waddell, TV Instructor at the Auckland Seddon Memorial Technical College and Bill Collett of King Edward Technical College Dunedin. Both gave up their holidays to spend the time working on the TV equipment in Wellington, and consider that the practical knowledge thus gained will prove invaluable. The advantages, however, were not all one-sided, and Messrs. Pye (New Zealand) Ltd. has expressed its very great appreciation of the work performed by these two TV enthusiasts.


* * *

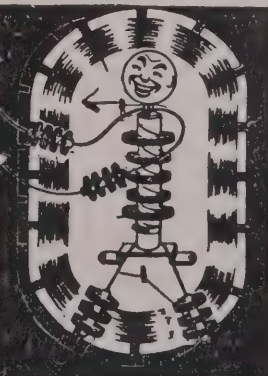
PRESENTATION OF TV EQUIPMENT TO KING EDWARD TECHNICAL COLLEGE DUNEDIN

The enterprise of the directors of the King Edward Technical College in providing instructional courses in television technique has been recognized in a very material way by Messrs. Pye (New Zealand) Ltd., who have presented the College with a TV receiving set. The College thus has become the first school in the South Island to have television equipment for the training of future television technicians.

This receiver with its 14 inch screen and operated by only two controls, will be used as a guide for students working with the six new kitsets. Later it is possible that a TV camera will be made available to the College for a short time to enable students to send and receive pictures. Plans are in hand for the building of the College's own camera, and recently an order was placed in America for the tube. When the project is completed, the King Edward Technical College will operate closed circuit TV.

**SPECIALISTS IN A
SPECIALIZED FIELD.**





MR. SERVICEMAN.

Our Universal Coils, types 40 (Aer), 45 (R.F.) and 41 (Osc) will replace any damaged R.F. Coil.

Inductance Specialists

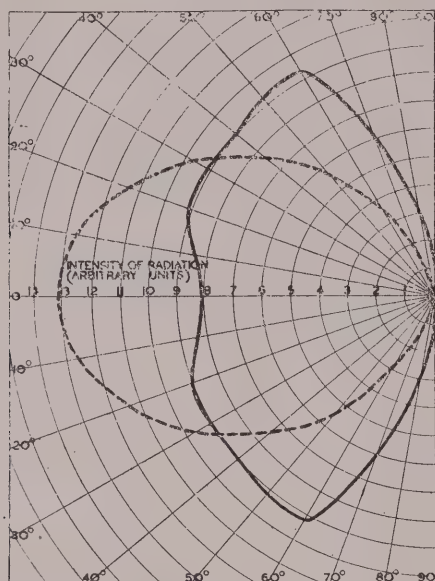
THE P.A. BROS. FREQUENCY SPECIALISTS
88 SYDENHAME ROAD, WELLINGTON, N.Z.

COILS, I.F. TRANSFORMERS,
R.F. COILS, R.F.O.'S, DIALS,
SCALES, COIL ASSEMBLIES,
GANGS, BUILT-UP UNITS, ETC.

Science Applied

Our most commonplace appliances are constantly being improved by the application of scientific principles to their design. For instance, how many of us would think that by a more careful application of the principles of optical reflection, the ordinary two-bar electric heater could be greatly improved?

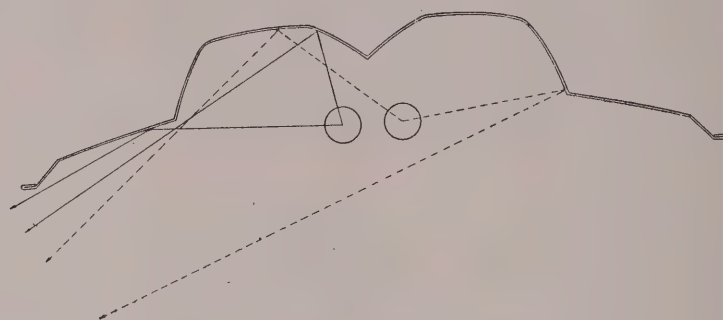
We all know the usual style of two (or three) bar heater, in which each element is backed by a



small parabolic reflector, whose job is to concentrate the radiant heat in a forward direction. One of its shortcomings is that it often produces a great deal of radiation directly in front of it, at the expense of places in the room that are off to one side. A more

even distribution of radiant energy round the room enables more people to be comfortably seated round the heater, and prevents those directly in front from being unwillingly roasted at the expense of those at the sides, who equally unwillingly freeze!

This British design places the two elements close together at the centre of a reflector whose shape is designed on optical principles so that there is an even distribution of radiation over an angle of 120 degrees—60 on either side of the centre—as compared with only about half this figure for more conventional designs. The diagrams show the shape of the reflector system, which is made up of a number



of parabolic sections, and the heat distribution actually achieved. In the latter, the dotted curve shows the much sharper distribution obtained with conventional reflectors.

Another advantage of the design is that when one element is turned off, the distribution of heat in the room is almost unaffected, since both elements are very close to the axis of the reflector system. (Diagrams by courtesy of Messrs. British General Electric Co. Ltd.)

IN CONFERENCE

H.M.V. DEALERS' CONFERENCE

So successful was the recent H.M.V. Dealers' Conference held in Wellington, that H.M.V. (N.Z.) Ltd. are now considering holding these at regular intervals.

For three days, dealers from the North Cape to the Bluff enthusiastically discussed the present range of products, future production and general merchandising policies.

The conference was opened by Mr. A. J. Wyness, Managing Director, who welcomed the dealers and visitors and after a short address by Mr. R. Bull, Mr. E. J. Isaac chaired a discussion on recordings, which covered a wide variety of subjects including general marketing and future production. Dealers were gratified to learn that H.M.V. had plans near fruition for greatly increasing the present pressing of recordings which will be carried out in their new Petone factory.

The following two days chaired by Mr. Sam Heginbotham were devoted to all other branches of the organization and these discussions were extremely helpful, more especially so in the planning for future radio models.

Mr. Ray Cunningham, refrigerator cabinet manufacturer, was introduced to dealers and a very interesting and informative discussion concerning refrigeration generally ensued. Mr. John Scott of J. and A. P. Scott of Dunedin, manufacturers of the H.M.V. washing machine, also addressed dealers concerning this household appliance and stressed many of its salient selling features.

A talk on remote control by radio by Mr. Les. Wright, inventor of the H.M.V. Remote Control Unit, gave his listeners an insight into the many purposes of this instrument. Dealers were later fascinated by the wonderful manoeuvres of a model aeroplane controlled by one of these units in a demonstration given on the Miramar Golf Links.

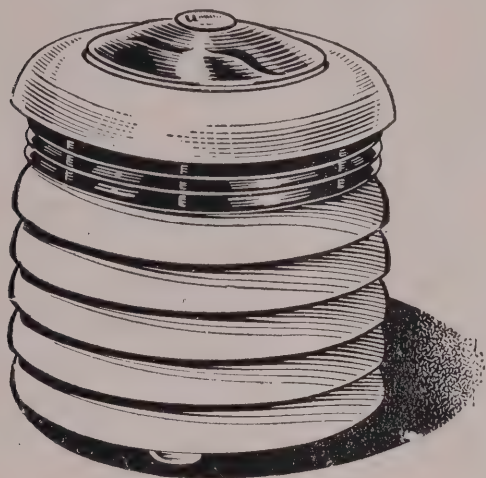
A new feature in conferences perhaps was a full report of the discussions made on the well known E.M.I. Tape Recorder, the performance of which aroused much favourable comment.

The social side was not forgotten as visitors exchanged pleasantries at a cocktail party on the Tuesday evening and at a film evening and supper party on the Wednesday. Visitors' wives too enjoyed the hospitality provided by H.M.V. (N.Z.) Ltd.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

THE ULTIMATE GLO-WARM



The hottest news in the fan industry is the ULTIMATE GLO-WARM priced at only £18 7s. 6d., manufactured and distributed by Radio (1936) Ltd.

This fan heater, which warms the whole room by its even distribution of pre-heated air, safeguards health, gives compactness with efficiency, and combines appearance with robust construction. It is a fast-heating, highly effective space heater.

There is no longer any need to be tied to one spot in order to keep warm, so the risk of chills is reduced to a minimum. The heater is very light for ease of portability, and is constructed of non-tarnishable materials.

The design of the radiator eliminates any possibilities of shock or burns, as the heater is a heavy duty, spiral wound, long life element mounted on ceramic insulators and enclosed within the body of the radiator. No exposed parts of the "GLO-WARM" reach more than warm, so clothes can be aired near it with perfect safety. In the event of a rise in temperature due to any cause such as a motor failure or clothes falling on top of the radiator, a thermostat will come into play and switch off the element. The fan is driven by a trouble-free, quiet-running, English motor with self-lubricating bearings.

This space heater has been designed so that its appearance will assist its functional operation. The domed top is a baffle supported above three annular chromed steel rings between which is passed the greater part of the warm air. These three rings are rigidly suspended above six heavily-moulded deflector plates, which glow cosily in operation. The whole assembly is mounted on rubber feet.

A switch on the base enables the heater to be on high or low heats.

This radiator is the answer to room space heating with complete safety.

Specifications:

Size: 12 $\frac{3}{4}$ in. diameter, 13 $\frac{3}{4}$ in. high.

Rating: 2000 watts.

Length of Power Cord, 9 feet.

Finish: Ivory or Mahogany.

Orders for early delivery being taken now by RADIO (1936) Ltd., P.O. Box 1166, AUCKLAND.

THE AUTOCRAT PORTABLE CAR RADIO



The Autocrat Portable Car Radio is the first radio in New Zealand to be specially designed for use in a car and in the home. The many advantages of a radio of this type are sure to make it as popular here as it has been overseas. The "casual" motorist particularly is going to welcome a radio that he can use as a conventional car radio and as an ordinary mantel model as the occasion demands.

In a car the Autocrat Portable Car Radio simply needs connecting to battery and aerial and it is immediately ready for use. No special mountings are required as the Autocrat Portable Car Radio can stand on the floor, on a seat or anywhere that's convenient.

In the home this model is used in the same way as a conventional mantel set. A trailing aerial is provided, so all that is necessary is to plug in to the domestic power supply (230 volts A.C.). The uses of the Autocrat Portable Car Radio are not restricted to those mentioned above. It can be used

(Continued on next page.)

as a battery model, on boats, in caravans, anywhere in fact.

The **Autocrat Portable Car Radio** is a 6-valve Broadcast receiver, with provision for the use of an extension speaker. Models can be supplied either as 6-volt or 12-volt depending on the makes of car for which they are required. The cabinet is hard baked enamel hammer finish. Retail price £37 19s. 6d.

The **Autocrat Portable Car Radio** is manufactured by Autocrat Radio Ltd., Great South Road, Auckland. Sole New Zealand distributors: **G. A. WOOLLER & Co. Ltd.**, Box 2167, Auckland.

PYE'S NEWEST A 6-VALVE BANDSPREAD

Yet another new model from Pye (New Zealand) Ltd. is now on the market.

This mantel model, to be called the "69," was designed by the skilled craftsmen of Pye Ltd., Cambridge, England, and has proved to be a most popular model on all markets.

By incorporating the most modern type of valves, the "69" has the performance you would expect from a console model, while the 8 band Bandspreading is a luxury feature provided at a surprisingly low cost. The bands covered, aside from Broadcast and Medium Short Wave, are 31, 25, 19, 16, 13, and 11 Metre Bands.

The cabinet of Sapele Mahogany is of an attractively bold design, embellished with pleasantly contrasting loudspeaker covering, dial etc. The dimensions of this convenient table model are 19½ in. x 8 in. x 14½ in.

The loudspeaker is a 6½ in. P.M. Moving Coil Type, and sockets are provided for an extension speaker of 2-4 ohms impedance. Facilities are also included for a Gramophone Pick-Up. Among the other features of the Pye "69" are: Twin Vision Tuner; Tonemaster Switch; fly-wheel tuning; moulded edge-lit perspex dial.

Retail Price: £39 17s. 6d.

FOR THE TECHNICIAN

H.M.V. Controlled Heat Iron, Model No. 4A

SPECIFICATION

This is a most popular model iron with heat control and indicator light.

Weight.—4 lb. 6 oz.

Sizes.—4 5/16 inches high, 4½ inches wide, 8¾ inches long. It is supplied with 9 feet of three-core braided cable and should, wherever possible, be connected to a three-pin plug (red to "L," black to "N" and the third lead to "E"). It is not advisable to connect the iron to a light socket, and in the case of the 110-120-volt model this must never be done. For the 200-210, 220-240 and 250 volt models 5 amp fuses are required but for the 110-120 volt model, fuses of at least 10 amps must be fitted.

The standard models are:—

	110-120 volts, A.C. only
	200-210 " " "
(All elements	220-240 " " "
are rated at	250 " " "
750 watts	200-210 " A.C./D.C.
nominal)	220-240 " " "
	250 " " "

The only difference between the A.C. and A.C./D.C. models is the inclusion of a small condenser (0.02 mfd.) in the latter across the thermostat contacts to prevent excessive sparking on D.C. Lamp.

Lamp

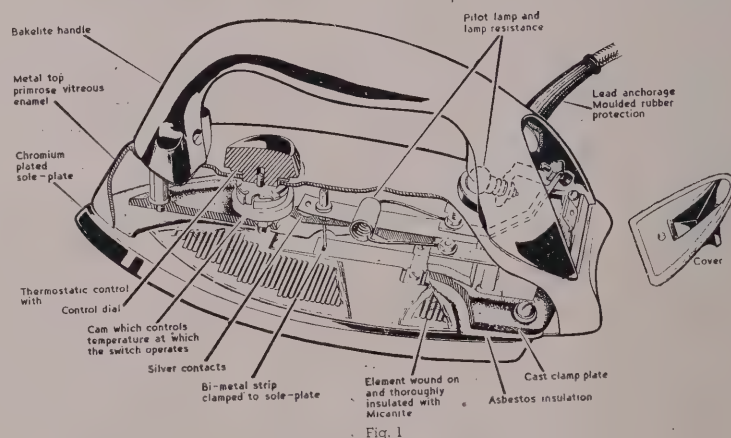
The indicator lamp fitted to all models is rated at 3.5 volt 0.3A. Part No. 61178-A.

The method of fitting a new lamp is clearly shown in the instruction card. It is not always advisable to screw the lamp as far as it will go into its carrier bracket, or difficulty may be had in getting the lamp to sit properly.

TECHNICAL DESCRIPTION

The construction of the iron will be clearly seen from Fig. 1 (cut-away view of iron). The cast sole plate, to which is screwed the bi-metal strip, has also three tapped holes for the screws securing the element clamp. The front one of these three screws is actually a special stud, the upper part of which carries the porcelain heat setting cam.

The thermostat, which is operated by a small adjusting rod from the bi-metal strip, is secured to the element clamp as a sub-assembly. The vitreous enamel top with control knob separates cleanly from the rest of the iron when the handle fixings are removed; the porcelain cam is slotted to engage with lugs screwed to the control knob which is assembled on to the top.



The circuit diagram is given in Fig. 2 The thermostatic control is obtained as follows:—

As the iron heats up the bi-metal strip bends upwards owing to the higher coefficient of expansion of the lower layer of metal. This allows the contact springs which are connected to the bi-metal strip by the adjusting rod, to rise together (i.e., made). They continue to rise until the end of the lower contact spring meets the underside of the porcelain cam and is thus stopped. The level of this underside is determined by the cam shape and is adjusted by the temperature setting knob. Further rise in the bi-metal strip therefore allows only the top contact to move and the circuit is broken. Cooling of the sole plate reduces the bend in the bi-metal strip until the circuit is again made by the closing of the contacts.

SERVICING AND MAINTENANCE

Preliminary Tests

(1) Inspect iron for mechanical damage and check connections at both ends of lead.

(2) Check lead for continuity and test insulation between mains, leads, and earth wire. This should be not less than 2.0 megohms measured on a 500 volt Megger. This figure may be slightly less if the iron has not recently been heated up, due to absorption of moisture by asbestos pad. This moisture will be dispersed under operating conditions.

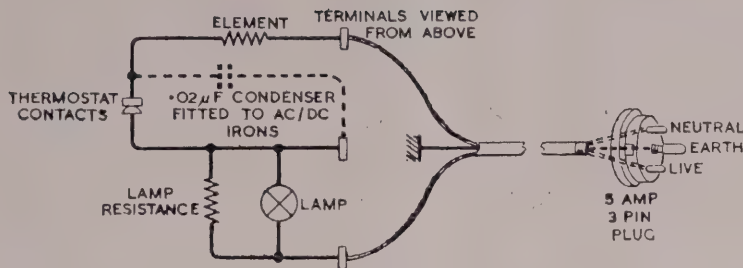


Fig. 2

(3) Examine lamp and if necessary replace.

(4) Check element and switch by measuring with an Avometer across the centre and right-hand connecting terminals.

Voltage	Approx. resistance				
	—ohms				
110-120	16
200-210	56
220-240	70
250	83

If an open circuit is obtained, element or switch is faulty, proceed to "Setting Thermostat" or "Replacing Element." If a short is obtained, proceed to dismantling (see "Setting Thermostat") and visual examination. If a much lower value is obtained, element is faulty, proceed to "Replacing Element."

(5) Check lamp resistance between centre and left hand connecting terminals. This should be approximately 1 ohm for 200-250 volt models or 0.4 ohm for 110-120 volt model but the lamp in parallel reduces the measured resistance considerably in all models.

(6) Check the temperature setting by connecting to correct voltage supply, turning control knob to "LINEN" and placing iron centrally on temperature measuring plate. The lamp should go out at a temperature of not more than 245 deg. C. The temperature may continue to rise a little more after the lamp goes out, but should never exceed 250 deg. C. If an ammeter is connected in circuit the current readings when the element is on should be as follows:—

Voltage						Approx. current —amps.
110-120	..	..	..	..	..	6.7
200-210	..	..	..	..	..	3.7
220-240	..	..	..	..	..	3.3
250	..	..	..	..	..	3.0

If incorrect operation is obtained, proceed to "Setting Thermostat."

It must be emphasised at this point that although temperatures for setting-up operations and general testing may be measured by means of temporary fixtures such as a thermometer inserted in a drilled brass block which is placed in close contact with the sole plate, a device of this nature should not be regarded as permanent service equipment. Such an arrangement is slow in action and generally inconsistent in measurement due to the precarious nature of the contacts between the soleplate, brass block and thermometer. For expeditious and really accurate servicing the E.M.I. Service Iron Tester, Stock No. Q.2571, should always be used. An illustrated technical leaflet is available from E.M.I. Suppliers, P.O. Box 296, Wellington. It can be used to set up all types of H.M.V. Irons and most others and, as a piece of modern service equipment, it is as essential to the domestic appliance dealer as the analyser is to the radio engineer.

Setting Thermostat

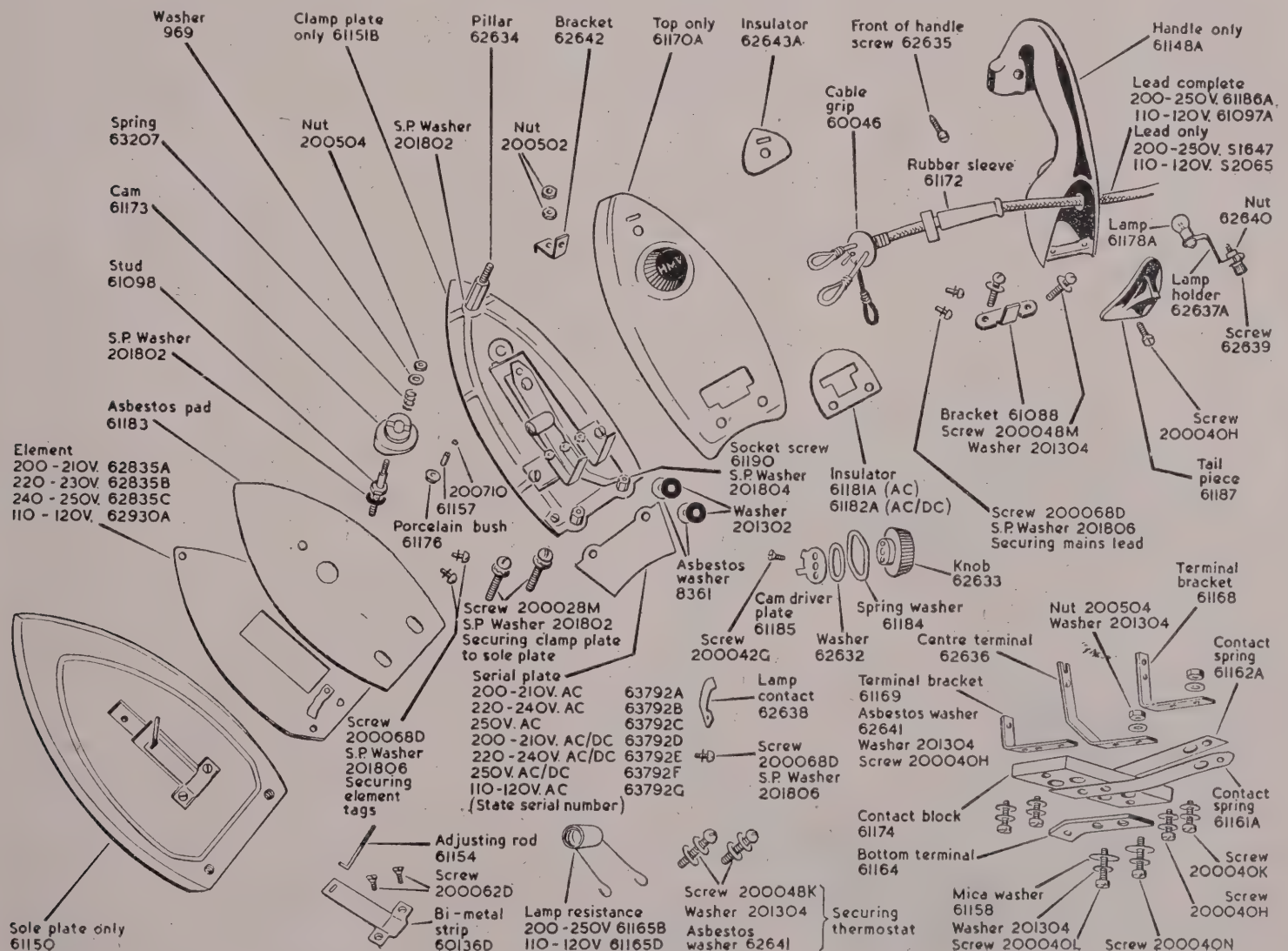


Fig. 4

Proceed as follows:—

(1) Remove lamp, disconnect leads from connecting terminals and remove the two screws securing the handle at the heel end.

(2) Remove single screw handle at toe and remove handle with lead.

(3) Remove lamp-contact plate from one of the connecting terminals and the metal handle securing bracket (toe end).

(4) Remove two asbestos gaskets and lift off vitreous top.

(5) Replace the lamp-contact plate and lamp (this is only necessary if there is no ammeter included in the test equipment available) and reconnect the leads.

(6) See that the contacts of the thermostat are not either welded together or badly burnt (in either of which cases the entire switch should be replaced) and place the iron on the temperature measuring block.

(7) See that the porcelain cam is in the position for "LINEN," i.e., with the slots in the cam going across the iron, the wider one on the left, and switch on.

(8) Slacken the small lock-nut on the bi-metal strip adjusting rod and adjust the long nut to give thermostat cut-out at 245 deg. C. Screwing the nut down will increase the temperature and vice versa. **TAKE CARE NOT TO TOUCH LIVE PARTS WHILE MAKING THIS ADJUSTMENT.**

(9) Allow one or two cycles of thermostat operation to take place and see that the temperature never rises above 250 deg. C., then lock the adjustment with the lock nut and re-check temperature. Switch off.

(10) When the iron is cool, note that the contacts are made at all positions of the heat setting cam.

Replacing Element

(1) Do operations 1 to 4 above; then disconnect element leads, and remove both nuts and porcelain bush from the bi-metal strip adjusting rod.

(2) Remove nut and coil spring securing porcelain cam and with a box spanner (2 BA) remove the special stud.

(3) Remove two screws at heel of element clamp plate and lift off plate complete with thermostat.

(4) Remove asbestos pad and element.

(5) Brush sole plate (including bi-metal recess) clean off all grit. Replace in the reverse order using new element and asbestos pad if required.

(6) Re-set thermostat as above.

Replacement or Repair of Thermostat

To obtain access, do operations 1 to 4 of "setting Thermostat" above.

To remove thermostat proceed as follows:—

(1) Remove two screws securing porcelain support to cast clamp plate, and two nuts and porcelain washer on adjusting rod.

(2) Remove metal and asbestos washers and withdraw thermostat.

If the silver contacts are slightly burnt, they may be cleaned with fine emery cloth. The lower one should be flat and the upper one rounded. If the springs have lost their temper due to faulty condenser (A.C./D.C. model) or any other cause of over-heating, or if the contacts are welded, due to the iron having been used on wrong voltage mains, or A.C. model used on D.C., replace the thermostat complete. Proceed to setting thermostat as above.

Bi-Metal Strip

It is extremely rare for faults to occur in the bi-metal strip. Extraneous matter under it may prevent it from returning to its flat position, thus preventing the thermostat from switching on again, particularly at low settings of the control. If switching is erratic with consequent wide variations in temperature, check bi-metal strip fixing screws.

Access to the bi-metal strip is obtained by removing the element (see above). When re-assembling a bi-metal strip ensure that the adjusting rod is in position with the tongue of the hook pointing towards the front of the iron.

Temperature Range

The total range of temperature the iron is designed to cover is from approximately 130 deg. C. at the lowest (RAYON), setting to 250 deg. at the highest.

Condenser

On A.C./D.C. irons a 0.02 mfd. condenser (Part No. 25074A) is fitted—one end to the bottom terminal (Part No. 61164) together with the element tag; and the other end to the centre terminal (Part No. 62636) by means of the screw and nut.

General Notes on Re-assembly

(1) When fitting element clamp, screw front screw home first, then two rear screws. Do not omit to insert the serial number plate between the asbestos pad and the sole plate with the name downwards.

(2) Replace all shake-proof, plain and asbestos washers in the correct positions.

(3) Check that the single screw fixing the operating lugs to the control knob is tight before replacing top.

(4) Tighten (but do not over-tighten) two rear handle securing screws (with the earth lead under one of them) before tightening the front handle securing screw.

(5) See that the cord in the lead is tied to the cable grip.

(6) Check that the correct customer's plug is properly fitted to lead. If it is a two-pin plug ensure that the earth lead is cut-off close and taped; if it is a bayonet one advise the customer to have a point fitted.

(7) If the appearance of the iron is not up to standard, for example due to scratched sole plate or discoloured or chipped top, change to new parts if the client is agreeable, and advise her on the correct treatment of the iron and the use of the H.M.V. iron stand.



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New Zealand Distributors:

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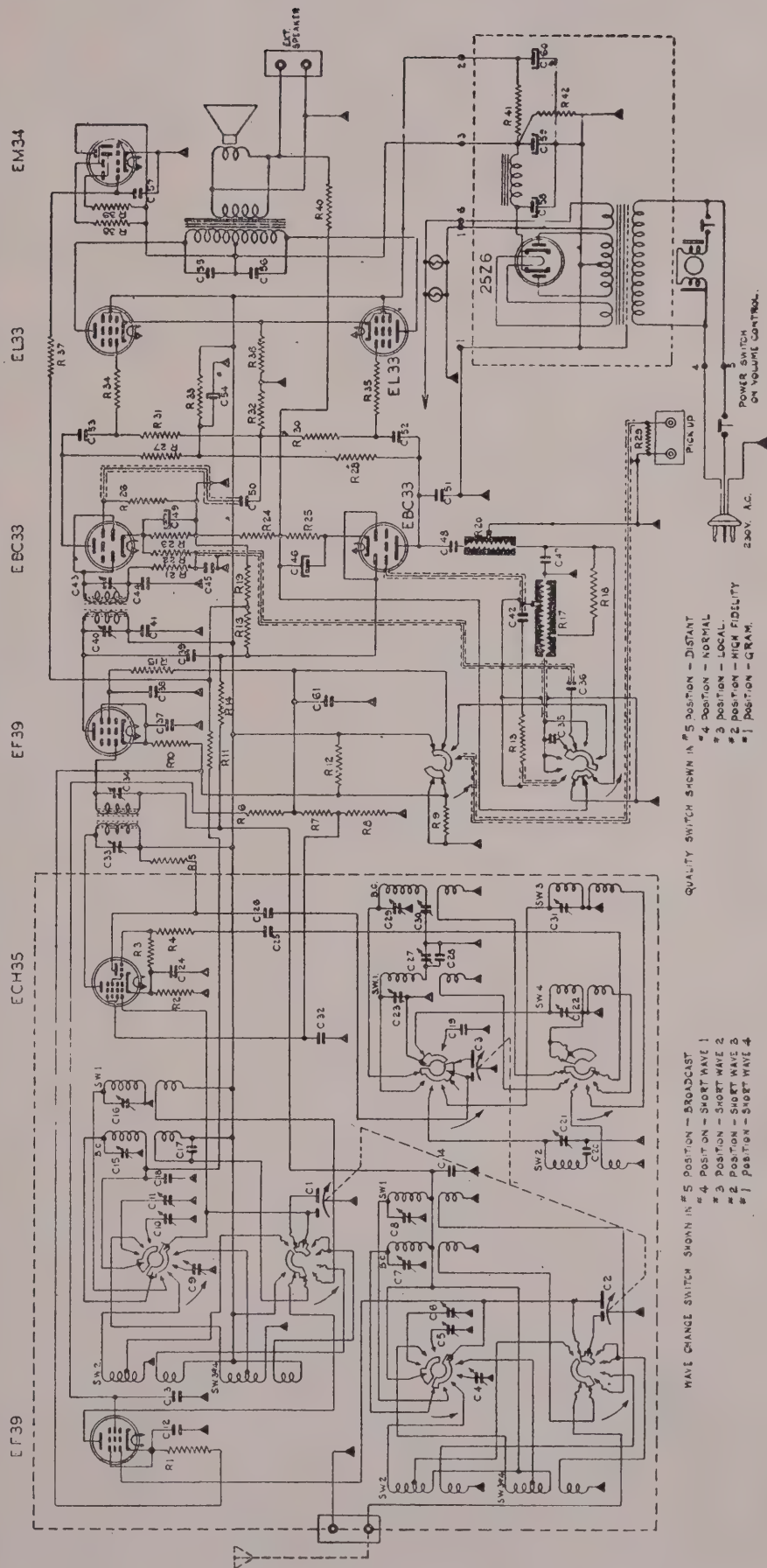
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THE PHILIPS RADIO-LAYER MODEL 602

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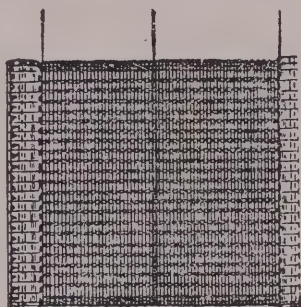


WAVE CHANGE SWITCH SHOWN IN "5 POSITION - BROADCAST"
 # 4 POSITION - SHORT WAVE 1
 # 3 POSITION - SHORT WAVE 2
 # 2 POSITION - SHORT WAVE 3
 # 1 POSITION - SHORT WAVE 4

QUALITY SWITCH SHOWN IN "5 POSITION - DISTANT"
 # 4 POSITION - NORMAL
 # 3 POSITION - LOCAL
 # 2 POSITION - HIGH FIDELITY
 # 1 POSITION - GRAM

- C1 } 3 gang split stator tuning condenser
- C2 } Triple
- C3 } Triple
- C4 } Triple
- C5 } Triple
- C6 } Triple
- C7 } Triple
- C8 } Triple
- C9 } Triple
- C10 } Triple
- C11 } Triple
- C12 } Triple
- C13 } Triple
- C14 } Triple
- C15 } Triple
- C16 } Triple
- C17 } Triple
- C18 } Triple
- C19 } Triple
- C20 } Triple
- C21 25-150 mmfd. trimmer
- C22 13-110 mmfd. trimmer
- C23 3-30 mmfd. air trimmer
- C24 .05 mfd. 100-400v. paper
- C25 100 mmfd. mica
- C26 100 mmfd. mica
- C27 450 mmfd. mica
- C28 400 mmfd. mica
- C29 3-30 mmfd. air trimmer
- C30 450-600 mmfd. trimmer
- C31 10-30 mmfd. trimmer
- C32 .05 mfd. 400v. paper
- C33 1 F. trimmer
- C34 100 mmfd. mica
- C35 .0047 mfd. 400v. paper
- C36 .001 mfd. 400v. paper
- C37 .1 mfd. 200v. paper
- C38 .05 mfd. 400v. paper
- C39 10 mmfd. ceramic
- C40 1 F. trimmer
- C41 .1 mfd. 400v. paper
- C42 480 mmfd. trimmer
- C43 1 F. trimmer
- C44 100 mmfd. ceramic
- C45 100 mmfd. ceramic
- C46 25 mfd. 25v. electrolytic
- C47 .0047 mfd. 400v. paper
- C48 .02 mfd. 400v. paper
- C49 25 mfd. 25v. electrolytic
- C50 .02 mfd. 400v. paper
- C51 removed
- C52 .02 mfd. 400v. paper
- C53 .02 mfd. 400v. paper
- C54 32 mfd. 350v. electrolytic
- C55 .0047 mfd. 400v. paper
- C56 .001 mfd. 400v. paper
- C57 .05 mfd. 400v. paper
- C58 40 mfd. 400v. Triple
- C59 40 mfd. 400v. Triple
- C60 20 mfd. 400v. Triple
- C61 .1 mfd. 400v. paper
- R1 200 ohms. 1w. carbon
- R2 200 ohms. 1w. carbon
- R3 50000 ohms. 1w. carbon
- R4 200 ohms. 1w. carbon
- R5 25000 ohms. 1w. carbon
- R6 100000 ohms. 1w. carbon
- R7 100000 ohms. 1w. carbon
- R8 100000 ohms. 1w. carbon
- R9 5000 ohms. 1w. carbon
- R10 300 ohms. 1w. carbon
- R11 2 meg. ohms. 1w. carbon
- R12 25000 ohms. 1w. carbon
- R13 1 meg. ohm. 1w. carbon
- R14 2 meg. ohms. 1w. carbon
- R15 100000 ohms. 1w. carbon
- R16 100000 ohms. 1w. carbon
- R17 .5 control switch & tap
- R18 50000 ohms. 1w. carbon
- R19 1 meg. ohms. 1w. carbon
- R20 .5 meg. ohms. control
- R21 56000 ohms. 1w. carbon
- R22 470000 ohms. 1w. carbon
- R23 2500 ohms. 1w. carbon
- R24 5 ohms. 1w. carbon
- R25 2500 ohms. 1w. carbon
- R26 470000 ohms. 1w. carbon
- R27 100000 ohms. 1w. carbon
- R28 100000 ohms. 1w. carbon
- R29 25000 ohms. 1w. carbon
- R30 220000 ohms. 1w. carbon
- R31 220000 ohms. 1w. carbon
- R32 220000 ohms. 1w. carbon
- R33 20000 ohms. 1w. carbon
- R34 50000 ohms. 1w. carbon
- R35 50000 ohms. 1w. carbon
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- R37 1 meg. ohms. 1w. carbon
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The trade-marks were assigned on 29th July,
1953, by Standard Telephones and Cables Pty.
Limited, of 252-274 Botany Road, Alexandria,
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ness in which they were then in use.

NEW ZEALAND

EASTER SHOW

For residents of the Queen City, highlight of April will be the N.Z. Easter Show to be held in the Epsom Showgrounds from 10th to 24th of that month. Jointly sponsored by the Auckland Agricultural and Pastoral Association and the Auckland Manufacturers' Association, this show will uniquely demonstrate the way in which the primary and manufacturing industries of New Zealand supplement each other to further the country's progress and prosperity.

For the entertainment of all there will be the usual range of side-shows and evening programmes, to say nothing of popular broadcasts.

On the serious side, there will be exhibits of a very high standard demonstrating the country's primary and manufacturing resources. Not least among these will be the stands of well-known radio, electrical and home-appliance firms, the quality of whose goods set a standard throughout the country.

Unfortunately, the early date of our going to press prevents our obtaining full details of their stands from all of these exhibitors, but, for the benefit of readers, we are glad to publish a little pre-Show information from some of these manufacturers.

With its booths 98 and 99 centrally situated in Hall 5, Radio (1936) Limited, manufacturers of ULTIMATE radio and electrical appliances, will exhibit a comprehensive selection of radios, ranging in size from a neat, moulded four-valve bedroom receiver to a de luxe ten-valve lowboy radiogram. Of restrained, modernistic design and pleasing pastel tones, this section will contrast the spectacular electrical appliance display with its theme "Designed to Serve and Save in the Home."

The domestic appliance range will present seven types of radiators—from a neat single bar "cabin fire" to the latest non-directional fan heater. ULTIMATE safety jugs, electric kettles, toasters, the latest rangette with its simmerstat controlled hotplate and "bench-high" sand, a new compact cupboard heater for either vertical or horizontal mounting, and the latest heat controlled domestic iron which gained first place in the recent New Zealand Plastics Competition, will all present an attractive display of domestic necessities. Also represented in this section will be the ULTIMATE special

industrial electronic department with a group of small commercial amplifiers.

The whole of this well planned exhibit will be completed with a demonstration room for the convenience of interested buyers.

Ever attractive, this year the stand of DISHMASTER (AUCKLAND) LTD. promises to be the mecca of all housewives, with pride of place being given to its new revolutionary CLOTHESMASTER. This machine, with its beautifully finished cabinet of white, high lustre, heat resisting enamel on bonderised steel, houses a large rotary drum which will hold 9 lbs. of washing, and its exclusive sealed unit gearbox ensures trouble-free, lifetime service. World-favoured tumbled washing action removes every particle of dirt gently, yet thoroughly, after which the Clothesmaster dries the clothes bone-dry—or to the most suitable dampness for ironing. Indeed, it is the complete home laundry unit, bound to appeal to all economy and labour-saving-minded housewives. It is hoped, however, that they will not be so carried away by this new appliance as to overlook the other notable DISHMASTER products on view, especially the Kitchen Units, the Waste-master Garbage Disposer, and, of course, the Commercial Dish Washing Machines.

Once again, H.M.V. (N.Z.) Ltd. will present a beautifully arranged display of radios and radiograms together with its comprehensive range of household appliances, refrigerators, washing machines, etc. Attractively displayed on the walls of this maroon, grey and white stand, will be selections from the large range of records manufactured and imported by this company. Highlight of this firm's exhibit, however, will be the specially imported industrial television camera, which will be used to televise various sections and activities of the Exhibition, viewers being able to watch the proceedings on several receivers occupying central place on this well-designed stand.

We hope that this tiny glimpse into some of the "mysteries" of the Show will encourage readers to see for themselves "What New Zealand grows and makes—makes New Zealand grow."

NEWS FROM GOVERNMENT DEPARTMENTS

APPLIED MATHEMATICS LABORATORY APPOINTMENT

New director of the Applied Mathematic Laboratory of the Department of Scientific and Industrial Research is Dr. R. M. Williams who succeeds Mr. I. D. Dick recently appointed as assistant secretary of the Department.

R. M. Williams, M.A. (N.Z.), B.A., Ph.D. (Cantab.), was born at Christchurch. He graduated M.A. with honours in mathematics from Canterbury College in 1940, and was awarded a Shirlcliffe Fellowship. During the war he worked first on radar design in the Department of Scientific and Industrial Research, and later joined the British team of scientists in the U.S.A., working on the atomic project.

After the war Dr. Williams went to Cambridge and took the Ph.D. in mathematical statistics. Since 1949 he has been senior mathematician of the Applied Mathematics Laboratory.

PERLITE

During the last ten years in the United States of America a new industry has been developed by the production of expanded perlite, which is a light-weight mineral with important application in building construction. Some time ago New Zealand scientists assisted an industrial firm in locating perlite ores and investigated the possibilities of manufacturing expanded perlite from such local natural resources.

Certain types of acid rock containing combined or "dissolved" water (notably glassy rhyolites) will expand to as much as ten times their original volumes when heated rapidly to temperatures of from 900 to 1200 deg. C., and this produces a light-weight material of cellular structure known as expanded perlite. By correct selection of raw materials and control of furnace conditions, perlite can be expanded so that a cubic foot will weigh as little as 2lbs., or the various bulk densities can be varied to produce material of weights up 20lb. per cubic foot.

Two branches of the Department of Scientific and Industrial Research—the Geological Survey and the Dominion Laboratory—have investigated the possibilities of the production of expanded perlite from New Zealand's natural resources. The geologists have provided information on the localities in which perlite ores of good commercial grade can be found and the chemists have produced perlite in a pilot plant. These two branches have worked in co-operation studying the suitability of the perlite ores, and a physicist of the Dominion Physical Laboratory has assisted them. In the meantime an enterprising industrial firm has extended the search for areas in which perlite ore can be found in sufficient quantities and has commenced production of expanded perlite.

The rapid development of the perlite industry in the United States of America has been due to the use of expanded perlite as a lightweight material for replacing sand in hardwall and acoustical gypsum plasters, for it has many advantages over the sand-type of plaster. Other uses are as a loose-fill insulation for refrigerators, fire-proof safes, etc., for making light-weight insulating concrete—though it has its limitations as an aggregate—and, in various bulk densities, as a component in many materials where lightness and unique insulating properties are required without load bearing.

SITUATIONS VACANT

SALES ENGINEER, with good practical experience in radio telephone equipment and with sound commercial record. Position of responsibility carrying good salary and allowances commensurate with ability. Address applications personally to Mr. R. D. Joseph, Industrial Electronics Ltd., Box 5001, Auckland.

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CIRCLING THE GLOBE

TV IN AUSTRALIA

During the Royal visit to Australia, the spanning of the Sydney Harbour from Farm Cove to the Spastic Centre at Mosman with an outdoor television link introduced the first television radiations in Australia. All previous televizing had been relayed by a physical line in the form of a coaxial cable.

However, owing to the narrowness of the beam projecting the television which was contained within an angle of two degrees, it was not possible for those possessing TV receivers, other than at the Spastic Centre, to pick up the programme.

Two Marconi Image Orthicon cameras were used to follow the proceedings continuously. Their pictures, however, were fed to a mixing unit, where a controller watching two screens was able to select and radiate the picture of greater interest. Each camera was fitted with a turret of lenses, including telephoto, which by varying the camera's viewing field from long-distance to close-up, afforded the engineer-producer controlling the mixing unit a wide range of pictures from which to select the programme.

These cameras take their name from the special pick-up tube which substitutes for the human eye behind the lens. Its ability to pick up pictures in poor light, being one hundred times more sensitive than the fastest film, has led to the selection of this camera by the BBC for all out of door broadcasts, or use in interiors that, for any reason, cannot be brilliantly illuminated.

RADIO INSTALLATIONS ON TRAWLERS

In these days when fishing is big business, trawlers go to sea fitted with every modern device to assist them in their work.

For example, the main telegraphic transmitter of the "Northern Crown" one of Britain's newest trawlers, is the well-known "Oceanspan," an H.F. and M.F. instrument which provides a total of 37 pre-selected "spot" frequencies, 30 of which are crystal-controlled in the H.F. band, the remainder being in the M.F. band. An "Electra" receiver covers the high and medium frequencies, and a "Yoeman" from 15 kc/s. to 25 mc/s. A "Seagull" radio-telephony transmitter/receiver provides speech communication and morse reception and the receiver also covers the frequencies of the Consol position-fixing system.

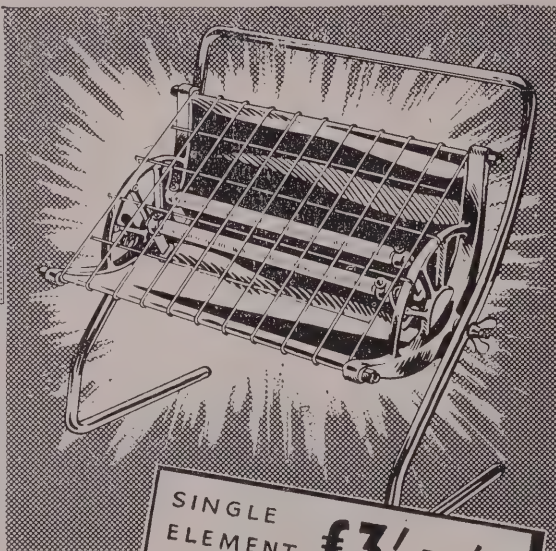
A "Lodestone" long-range direction-finder, a "Seapilot" direction-indicator and a "Seagraph" echometer aid navigation in all weather conditions. The latter is also a valuable aid to the fishermen in locating shoals of fish beneath the vessel and in revealing banks and ledges where fish are likely to feed.

No wonder the price of fish goes up!

Beauty

with SAFETY

Note the guard that covers the elements — it's a vital safety measure to prevent children or clothing from touching the red hot elements.

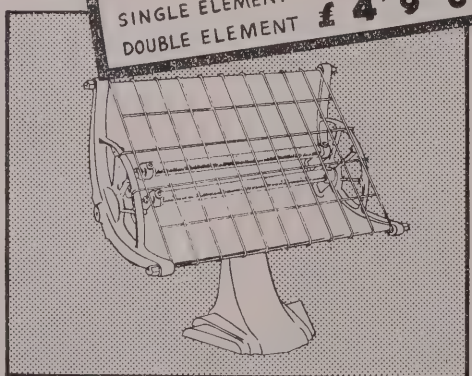


SINGLE ELEMENT £3' 17' 6
DOUBLE ELEMENT £4' 19' 6

Poweray

ELECTRICAL APPLIANCES

SINGLE ELEMENT £3' 7' 6
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The Electric Radiator you can trust!

Apart from being a SAFETY Radiator, the "Poweray" has a beauty of design and appearance that will enhance any room. Finished in chrome, with adjustable heat reflectors. **GUARANTEED**, 2 years (Elements one year). All double element models have switch to turn on one or both elements. For safety's sake buy a "Poweray" with the Safety Guard.

Poweray

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ELECTRIC RADIATORS WITH THE SAFETY GUARD

N.Z. Agents: C. & A. ODLIN TIMBER & HARDWARE CO. LTD., WELLINGTON.

OBITUARY

It is with great regret that we have to record the death in an aircraft accident of Mr. and Mrs. B. T. Giles. "Bernie," as he was known to everyone, was one of the notable figures in the post-war radio and electrical industries of this country, and his loss will be keenly felt. We feel we can speak for the whole industry in extending our sympathy to Mr. and Mrs. Giles's family in their loss.

SPECIAL LAMPS

(Continued from page 37.)

found day by day and the results are so astonishing that in fact new industries have sprung up for the building of ovens, tunnels, etc., in which these lamps can be used.

For medical purposes, too, infra-red lamps have been developed which emit energy of a specific wavelength capable of penetrating deep below the skin, thus making it possible for a cure to be effected or pain alleviated in many cases.

On the other side of the visible spectrum lie the ultra-violet rays, which, like the infra-red, are invisible. This is also a field that is being fully explored, and it presents many possibilities. It is already known that many people derive benefit from these ultra-violet rays in the winter and that they are used in curing children of rickets. Recently ultra-violet lamps have been developed which have a decided sterilising effect, and these are being used for sterilising the air in hospitals, operating theatres, doctors' waiting rooms, etc., and further in the foodstuffs industry where products are processed which are liable to deterioration through the action of micro-organisms such as bacteria and moulds.

SHOES AND SHIPS

(Continued from page 34).

television scheme, installing very large stations throughout the country, on the original 405-line system.

As has been demonstrated on numerous occasions, colour can be transmitted. However, this poses a number of problems. Even if it is not to be compatible (able to be received in black and white on ordinary receivers), it still complicates receivers and transmitters very considerably.

Also, there is no guarantee that the public want colour. No doubt they would be overwhelmingly in its favour if there was no difference in price, but if having it involves the outlay of another £50 or so in the price of a set, colour would come a very bad second. After all, when you come to consider it, colour on the ordinary cinema screen has never been a great attraction—witness the number of top grade pictures produced in black and white!

Summarizing, therefore, TV has been demonstrated; we have seen, and we have marvelled. It provides splendid entertainment and has achieved a degree of technical excellence far beyond that of ordinary radio broadcasting on its initial public introduction. Dare we hope that the near future will bring the operation of a TV service in New Zealand!



A bed's best friend

Cosicover

All-Wool Electric Blanket

The COSICOVER Electric Blanket is the perfect example of the "warmth without weight" ideal. Its initial cost is not great, and savings on future blanket purchases are considerable. Then, the COSICOVER itself is ALL PURE WOOL and can be laundered on removal of the heating pad. Single and double bed sizes available, both guaranteed 12 months. The COSICOVER has an enormous sales potential. Just display it on your counter. The weather will do the rest.

Further information from

THE
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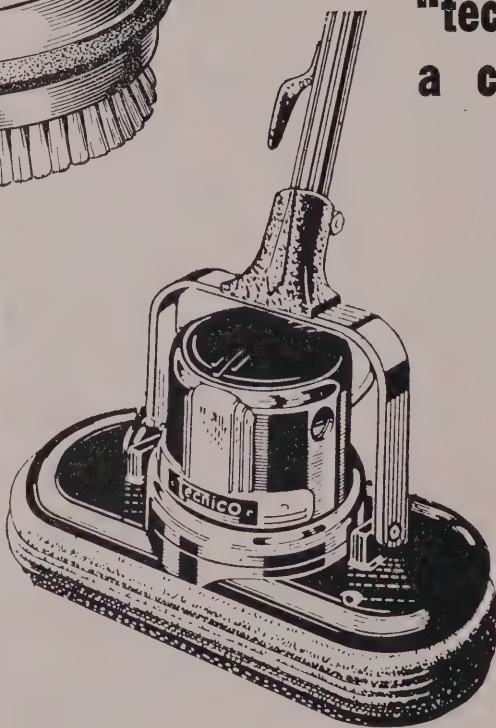
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A HEAVY-DUTY machine which gives perfect results HI-SHINE has been specially designed to fill the needs of Shops, Factories, Offices, Halls, Hospitals, Hotels, Restaurants. It is of sturdy construction and will withstand constant hard usage. Its maintenance record is unequalled. HI-SHINE is simple to operate and no strength is needed—it has only to be guided.

Tecnico

2-BRUSH or
3-BRUSH
POLISHER SCRUBBER

"tecnico" for
a choice of
6 GAY
SHADES



For the average home or flat, the lower-priced 2-brush Tecnico is ideal. This model is in walnut shade only. In large households, shops, offices, hotels, etc., the 3-brush Tecnico is the perfect machine to preserve floor surfaces with a finish that rivals a palace. The triangular head provides easy access to corners. This model available in Venetian Red, Ivory, Eau-de-nil, Dove Grey, Mushroom, and Walnut (all colours except standard Walnut at slightly extra cost) Recommended for wood, tiles, lino, terrazo, rubber, and smooth cement floors.

Sole New Zealand Distributors:

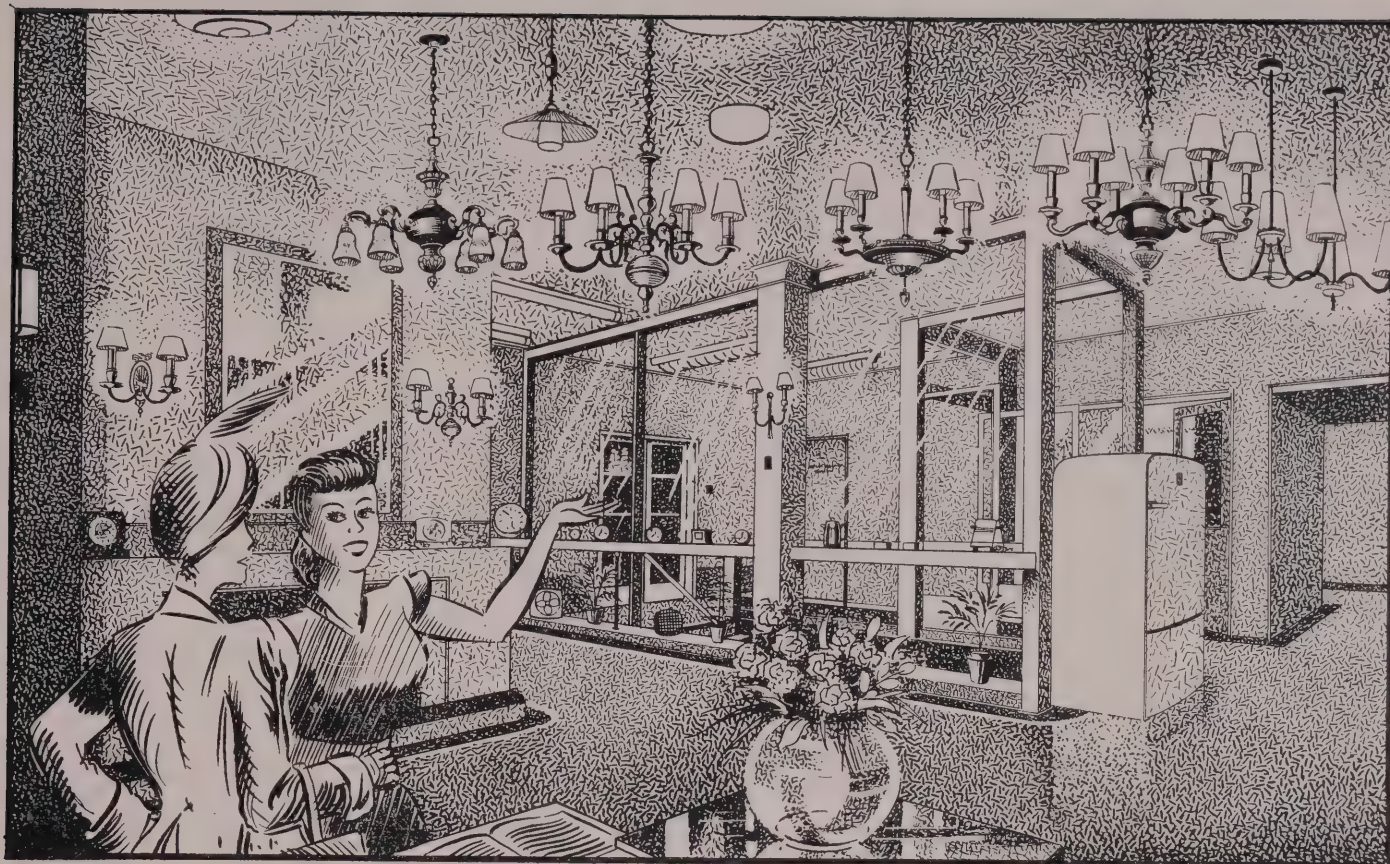
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If you have no showroom introduction tickets on hand, it is so easy to obtain a supply.

PIN THIS COUPON TO YOUR BUSINESS LETTERHEAD & MAIL TO YOUR B.G.E.C. OFFICE IN YOUR AREA

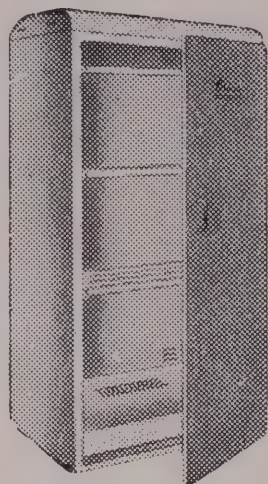
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GROVER

ELECTRIC CLOTHES DRIER

- All-steel Cabinet in baked enamel.
- Removable aluminium drying rails.
- Economical to run (400 watts).
- Economical in floor space (18 x 24 x 52 in. high).

Safety to Children assured by Guarded Element

Two models to choose from:

Forced Convection—

Green	£21/18/6
Ivory or White	£22/15/-

Natural Convection—

Green	£16/18/-
Ivory or White	£17/18/-



Presenting

THE "GROVER" TOASTER

- ★ Pleasing Streamlined Appearance
- ★ Heavily Chrome-plated
- ★ 600-watt Element
- ★ Guaranteed for 12 Months
- ★ Retail Price, £3 5s. 6d.

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In the Public Eye

This outstanding Portable Fan Heater, or Fan Unit, gives strength without weight, incorporates high quality English motor. Guaranteed 12 months. Working parts easily accessible.

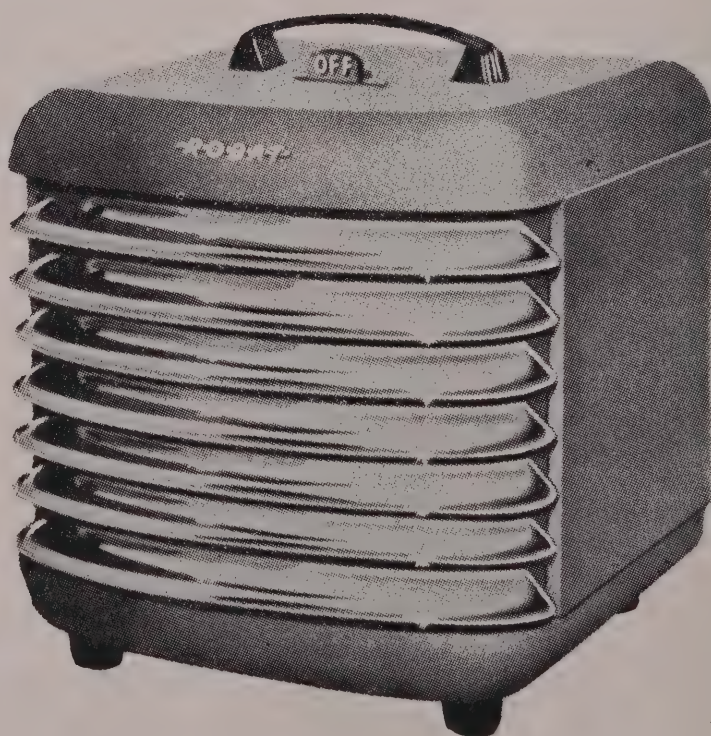
Obtainable through your whole-sale Electrical Merchants.

THE ROBAT PORTABLE FAN HEATER

Manufactured by

Robertson & Batchelor Ltd.

85 Clarence Road, Christchurch



MILLIWATT

FOR ELECTRIC PADS AND BLANKETS

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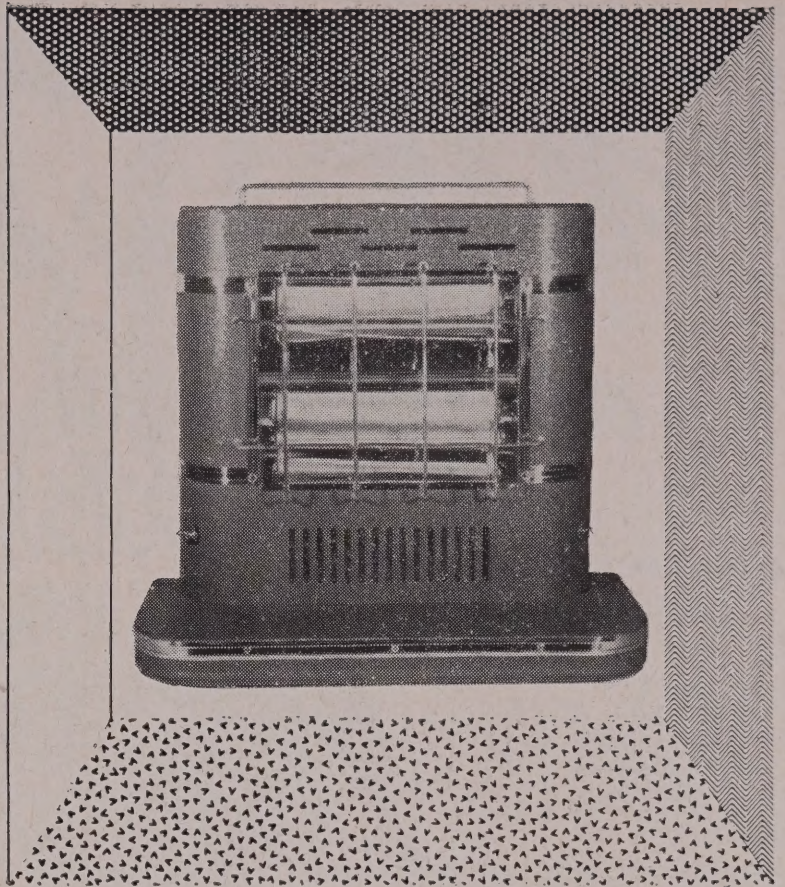
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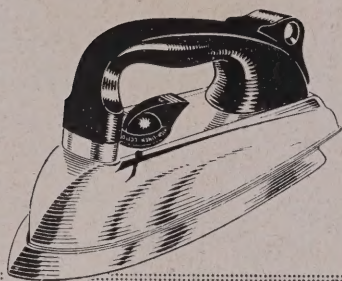
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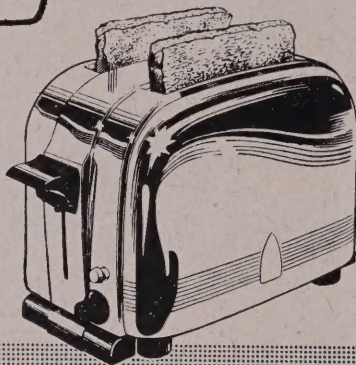
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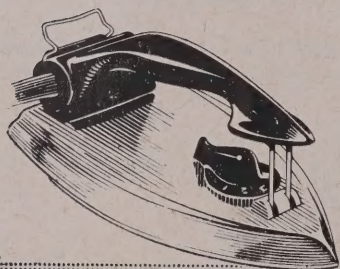
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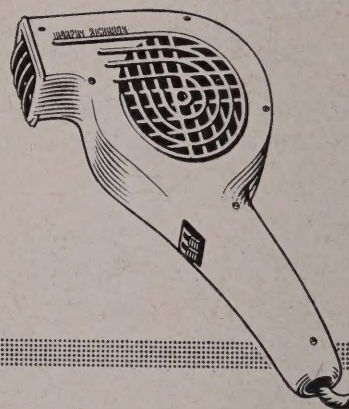
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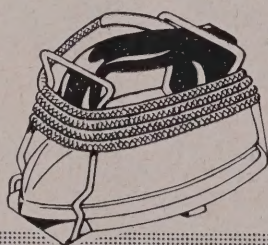
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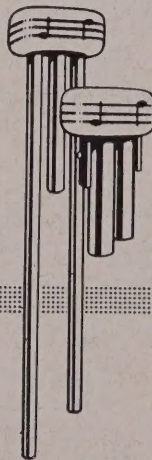
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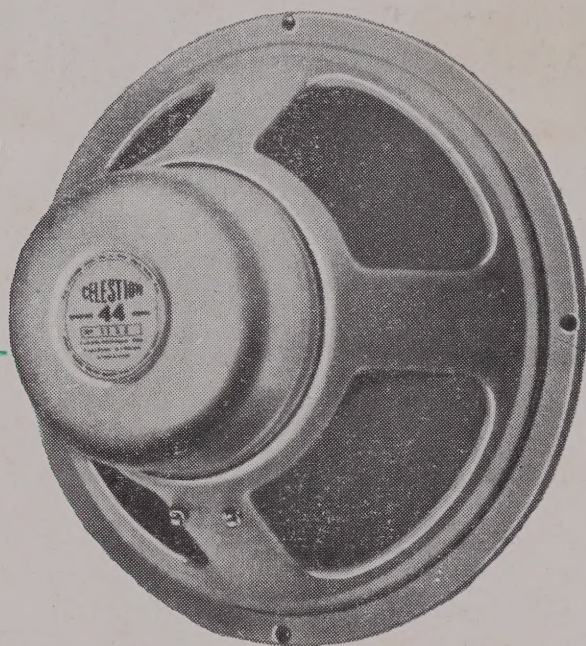
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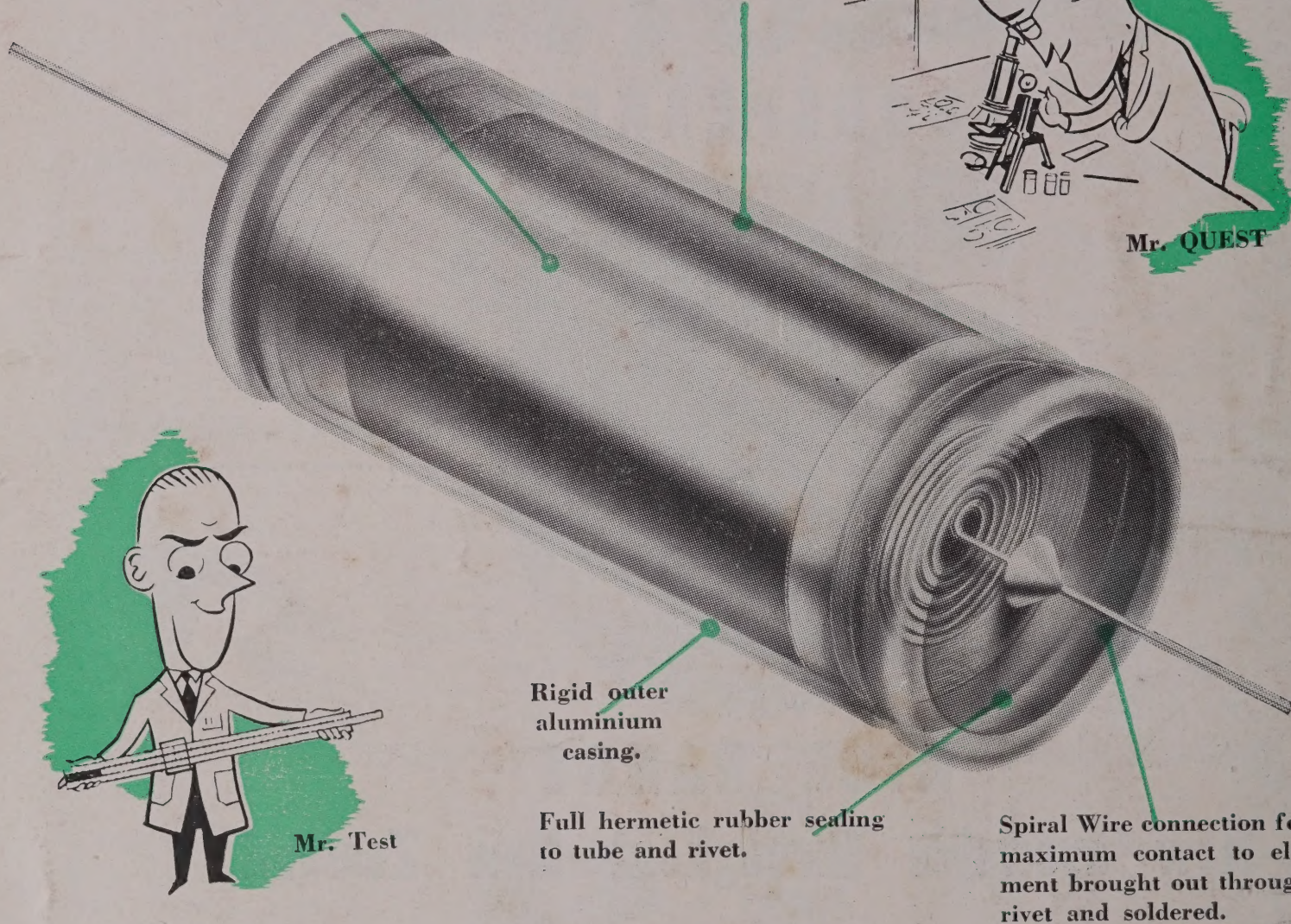
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